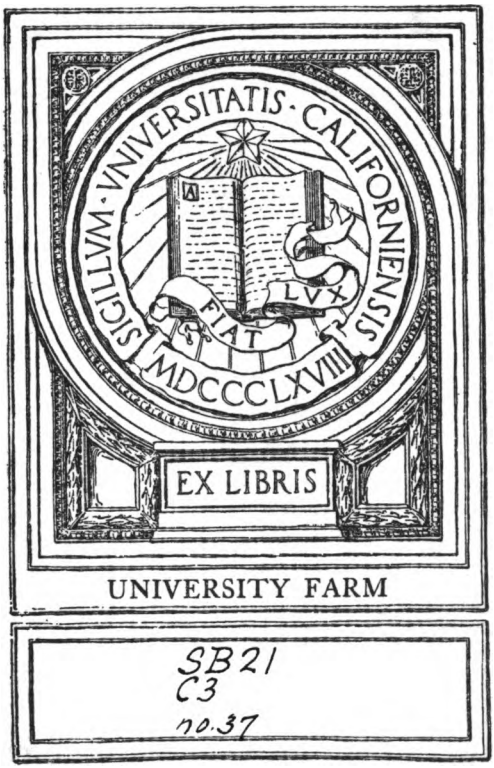
THIRTY-SEVENTH FRUIT GROWERS' CONVENTION

HELD AT POMONA
SEPTEMBER 13-14, 1910



PROCEEDINGS

OF THE

THIRTY-SEVENTH

FRUIT GROWERS' CONVENTION

OF THE

STATE OF CALIFORNIA,

HELD UNDER THE AUSPICES OF THE STATE COMMISSION OF HORTICULTURE, AT POMONA,

SEPTEMBER 13-14, 1910

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CALIFORNIA STATE COMMISSION OF HORTICULTURE.

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CAPITOL BUILDING, SACRAMENTO, CAL.

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FREDERICK MASKEW, *Assistant Superintendent*.....Sacramento

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Afternoon Session, 1:15 o'clock.

PROCEEDINGS

OF THE

THIRTY-SEVENTH CALIFORNIA STATE FRUIT GROWERS' CONVENTION.

POMONA, CALIFORNIA, September 13, 1910.

Pursuant to call, the Convention met at 10 o'clock a. m. and was called to order by Mr. J. W. Jeffrey, State Commissioner of Horticulture, Mr. Frederick Maskew, Assistant Superintendent of the State Insectary, acting as Secretary.

The Convention was opened with an invocation by Rev. C. B. Sumner.

PRESIDENT JEFFREY. We will now listen to an address of welcome by Colonel Firey, Mayor of Pomona.

ADDRESS OF WELCOME.

By Mayor F. B. FIREY.

Mr. President, Ladies and Gentlemen of the Convention: Your chairman showed himself something of a prophet when he announced that the preliminaries would not be very interesting. Notwithstanding the physical disability of a severe cold, I can not forego the pleasure of extending the welcome of one of the most progressive and up-to-date cities in southern California to the fruit growers of this favored land of ours. I take pleasure in calling your attention to the fact that we have no saloons in Pomona; but we have eighteen churches and one of the best libraries in the south with 18,000 volumes and one of the most accomplished librarians in charge. We point with pride to our polytechnic high school, and to our 2,500 children in the grammar schools and nearly 100 of the brightest schoolma'ms in all the land.

We feel it most fitting that this convention be held here since this is a distinctly orange growing section. We shipped this season about 3,000 cars of oranges, 90 per cent of these going through the San Antonio Fruit Growers' Exchange. This demonstrates the importance of our orange industry.

I have to admit that I don't know much about orange growing myself, having been in the business for only twenty-seven years. Advice is usually given most freely by those who have been here two or three years.

But orange growing is one of the most fascinating avocations ever indulged in, and the fact that a degree of prosperity has blessed the industry is due in no small measure to the California Fruit Growers' Exchange. The Exchange has returned to growers $14,000,000, and out of these vast collections less than $1,000 has been lost in the past six

years. During the life of the Exchange, $70,000,000 has been paid to growers and less than $5,000 has been lost. This is a very remarkable statement and shows the ability of the men at the head of the Exchange. It is purely coöperative and for mutual benefit.

I had something of a speech prepared, but I am something like the boy chosen by the graduating class to make a present to the teacher. When he stood up to make the presentation speech he found his mind a blank. Finally he blurted out, "Here it is Miss Jones; the boys told me to give it to you," and then sat down. I extend most cordial greetings to you. I know that the sessions of the convention will be profitable, and we shall hope to see its delegates in Pomona again. [Applause.]

PRESIDENT JEFFREY. We are very grateful to Colonel Firey for his words of greeting. Now we will hear from Mr. A. F. Call, a prominent attorney, but, better than that, a prominent fruit grower of his district. Mr. Call will speak in lieu of Mr. Story, who could not be present to-day. [Applause.]

MR. CALL. *Mr. President and Gentlemen of the Convention, Fellow Growers, Ladies and Gentlemen:* I thank you for this cordial greeting. It is unfortunate for you that Mr. Story was not able to be present this morning, for I apprehend that there is no one in southern California that could take his place and say to you what he would wish to say; for, with his twenty-five years of experience in the growing of fruits and his well known zeal in behalf of all the growers and his own experience as an organizer of the people in the protection of their industries, he can speak with an earnestness and enthusiasm for the cause that no other person could very well supply, and especially no stranger to the industry, for I regard myself as something of a stranger, only having been here for about three years. So, if I fail to express Mr. Story's views in this matter, you can attribute it to a want of knowledge and acquaintance with the subject that he would have.

But I know that you will all agree that he would wish me to very earnestly thank the Mayor and the people of Pomona for their cordial hospitality and for these words of welcome that have been spoken by their Mayor. And while, perhaps, he, if he were here, would not want to vouch for the absolute temperance of all the people that attend a meeting of this kind, I am sure that he would say that we will try to get along without the saloons during this convention, and that we will try to avail ourselves as much as we can of the numerous churches which are said to be in this locality. But while Mr. Story, I believe, if he were here, would say that we could get along without the drink, he would say he is glad to know there are so many nice schoolma'ms in this community and he would say, "Let the schoolma'ms come and we will receive them with open arms and hospitality." [Laughter.] And I know he would want me to thank the gentlemen of the State Horticultural Commission for their loyalty to this industry and to express our gratitude to the great State of California for what it is doing in our behalf, and to the gentlemen of the National Department of Agriculture who have spent so many years in their efforts to build up and protect our industry, and for their presence here and helpfulness during this discussion. I think I can say that their words of advice

and their help have fallen on fertile soil, for I believe I am safe in saying that there is no industry in the United States that has responded so rapidly and taken such close counsel of the advice of the state and nation as this industry of ours. In fact, it is a matter of remark in Washington, as well as in California, that their work is very greatly promoted and facilitated by the interest of the people whom they are trying to help. And I feel that I could say, without boasting, in behalf of these people, that the effort that they have made during the past twenty-five years in building up this industry is worthy of commendation on the part of the state and nation. It must be remembered that this is a new industry; that while the people of the old world have had long experience, we have had none, and that we have had to learn all this in the short space of twenty-five years. It is not like any other agricultural industry where the experience of our fathers has given us some start, but we have had to learn it all, and it is the most artificial agricultural industry that is known. Everything about that is artificial. We have to make the tree, in the first place, and we have to bring our water at the expense of millions of dollars for long distances, as much as 50 miles in some instances. We have to build up the soil—in fact, everything we do for the tree from the time it is first budded until the crop is ready to harvest is artificial in its nature. We have to try to take the place of Nature in all these things, and in doing this, the most difficult of all things, we have in our great measure of success, accomplished what no other industry has accomplished. In this short space of time we have set out 125,000 to 130,000 acres of citrus orchards in California. We have produced a property that is conservatively worth $125,000,000—a sufficient sum of money invested to build a railroad from California to Chicago and equip it in first-class shape. We have developed at least 25,000 inches of water and brought it in conduits to these groves, and this year, if no great mishap prevents, we shall ship 50,000 car loads to bring thirty-five millions of dollars. Such an industry as this is worthy of the fostering care of the state and nation, and the people who have done this must have brought to their occupation intelligence and industry and constant effort; and we are here to-day to gather these words of advice and take them home and apply them. We have been too long in the business to accept any man's dictum of what we ought to do. We know that we have got to work out our own salvation, but we also know that we can gather some information from every thinker who has thought upon these questions, and we can take home that part of it which fits our case and apply it, and we can all do better by what we have heard.

This industry is only in the beginning. We have yet to learn more than we have learned about it. The time will come when these orchards will spread over far more of the hillsides of California than they now do, when people will be eating citrus fruits of our production all over the United States, and when California will say, "The backbone of the State, the great financial interest of the State, is our citrus industry." I thank you. [Applause.]

PRESIDENT JEFFREY. The "Introductory Remarks" of the chairman is simply to tell you of the little difficulties he had in getting up this program during vacation. I will never undertake again to get

up a convention during vacation. The work of assembling the speakers for the program is a very difficult matter at any time of the year, but it is exceedingly difficult when all of the leading fruit growers of the State are away enjoying their well-earned rest at the mountains or the seashore. If there are any defects in the program, I want you to charge it to that, and not to any fault of the chairman. I had a great deal of difficulty and did not get the acceptances on the program in time to have this program published by the State Printer and sent out in order to advertise your meeting as we usually do; but if we had sent this program out with so many eminent names on it, perhaps there is no hall in Pomona that would hold the crowd. It is, perhaps, fortunate that we did not have the program circulated in advance. The convention itself was called at a very opportune time, but it takes a month at least to get ready for it.

I wish to say, in regard to my own address, that it is intended to be merely an outline, merely a suggestion or a series of suggestions about the business of this meeting, and when you get down to business, I want every delegate at this convention to come here as a working delegate. I hope every man who takes part in the discussion, will speak tersely and to the point. This is the largest gathering we have ever had, and this is the thirty-seventh convention. Now, we will proceed with the selection of our committees and the business of the convention, and I hope you will do it in a business-like way.

MR. DREHER. In behalf of the Executive Committee, I would move that Mr. Maskew act as secretary.

The motion was duly seconded and unanimously carried.

MR. MASKEW. Gentlemen, I thank you. I will do the best I can to get these papers in shape so they will be of value.

The chairman then appointed Mr. C. C. Teague, of Santa Paula, and Mr. John Scott, of Duarte, as vice-presidents of the convention.

It was moved and seconded that the chairman appoint a committee of three on Order of Business. The motion having carried, the chairman appointed as members of such committee, Mr. Wm. Chippendale, Mr. W. C. Fuller, and Mr. Edgar A. Wright.

PRESIDENT JEFFREY. Now, if I may have your patient consideration a little while, I will read the remarks I wish to make on the opening of this convention.

PRESIDENT'S ADDRESS.

By J. W. JEFFREY, State Commissioner of Horticulture, Sacramento, Cal.

When the great movement for the standardization of deciduous fruits began in the Sacramento and San Joaquin valleys last November, an entire session of the first mass meeting was devoted to finding out if the alleged orchard conditions and abuses of the fruit trade really existed. It was said that many orchards had been neglected, and that in consequence the fruit produced was not of first-class quality. Rumors were abroad that much of the grading and packing had been defective and unsatisfactory the preceding season, and it was held by many that if these abuses were not corrected the business would soon cease to be profitable. The session opened with the presence of nearly three hundred growers, and for awhile no one seemed willing to make a statement of any kind regarding the points at issue. Finally, one of the heaviest

shippers stood before the meeting and opened up the whole question by frankly stating his company's experiences and failures in handling its business the preceding year. Others followed, outlining the past conditions found in orchard and packing house, and in an hour those rival shippers and growers had set forth the true state of the deciduous fruit business as it had never been exposed in public before. Every man who spoke agreed that if improved measures were not soon adopted, the deciduous fruit business would continue to decline. The effect of these candid expressions from rival shipping concerns and of these neighborly confessions from the growers was immediate, and in all the thirty or more meetings that followed in different sections of the north to promote standardization, not one voice was raised in protest against exposing the facts regarding the decline of orchards, or the methods of handling the fruit. The result of these meetings developed the decision that the best way to standardize fruits is to improve the condition of the orchards, and I believe the revival of the deciduous fruit business of the north will date from the day the growers decided at these meetings to go to the basis of their troubles, just as I know you will do at this conference.

I have had in view just such a meeting as this for several years. The idea grew out of the first interview I had with Mr. Powell when he came here to begin the study of fruit transportation. At that conference with Mr. Powell I tried to convince him that our citrus fruit troubles would prove far more fundamental than those arising from the handling of the fruit; that many obscure problems would have to be solved at the producing end of the business, and that the start should be made in a broad and scientific way at the very seat of our difficulties, and carried clear through from that point, before the citrus industry would be placed on satisfactory ground. He agreed with me, but stated that the plans were all made to begin with fruit picking and that the investigation would have to proceed along the lines originally designed. The results of Mr. Powell's work were so immediate, so magnificent and so helpful to the growers that for a time I fear the questions upon which rest the very production of the fruit itself were obscured—the problems we are assembled now to consider. And now we are met here to face the real issue as best we may, and the issue is this: "Are our citrus groves to be long-lived, healthy, and productive, or are they to become decrepit, of short duration, and fruitless?"

We are here to try to analyze some of the cultural difficulties of citrus growing, and I believe the success of this meeting will depend upon what we do for the future in that way, and yet we may draw from experience much that should help in determining the course of future investigations. I ask you to join in organizing some practical means of looking into the questions we must face, and of bringing into better condition our declining groves.

OBJECTS FOR THE CONFERENCE.

The subject of orchard decadence is so vast and so obscure that I find great difficulty in presenting an outline of what should be considered by this convention. Yet it must be done if our deliberations are to be conducted in an orderly and effective manner. In presenting the following synopsis for discussion, I hope that the delegates will

remember that this is their convention; that the commissioner is subject to their orders, and that they will amend or change the order as they may deem proper. The objects of the meeting should be, in my opinion, as follows:

1. To determine, first, if there is a serious deterioration of the citrus fruit trees of the State, or a marked decline in the productiveness of our older groves where properly cared for.

2. If it is found that the orchard conditions are not what they should be, we should get all possible information before this convention relating to the causes of unfruitfulness and decadence, and from this information determine upon definite lines of scientific research for the future, and designate their character and scope. Also, by discovering to our best ability the causes and effects of orchard decline, to afford some present relief to the growers whose trees are not doing well.

3. Having decided upon definite subjects of research, to take steps to secure scientific experts equipped for long and patient investigation.

4. From the results of this conference we should make broad and positive declarations upon the present status of the citrus industry, that shall set forth to the public a correct view of the business from all sides; declarations which shall also present to the authorities that tax the land, fix tariff rates, levy freight charges and regulate interstate traffic matters, a clear statement of what would follow placing further burdens upon an industry already bearing more than its share of difficulties and responsibilities in building up the material interests of the State.

If the production of citrus fruits is in proportion to the vast capital it involves, and the tonnage of crops commensurate with the risk and labor necessary to maintain the orchards, there is no question before us. But let us inquire if the reverse is not true in many cases. Are we not justified in holding this conference upon the subjects named in the call? Is there not a considerable acreage of our citrus fruit trees suffering from decrepitude, decline, or other cause of unfruitfulness? Are not some of our groves, which receive the best of care, failing to respond with profitable crops? I think we can find the answer in the tonnage shipments of the last few years, if we take them in connection with the vast acreage of oranges and lemons that has come into full bearing during the time covered by the late shipping reports.

Excluding the citrus fruit season of 1908–09 there has not been a material increase of citrus fruits during the last ten years. The total output of oranges and lemons for the ten years closing in 1908 was 248,206 car loads, a yearly average of 24,820. This average was exceeding nearly a hundred car loads by the crop of 1900–01, in which nearly 25,000 car loads were produced. Of course there has been a gradual increase of tonnage during the last decade, but the 30,000 mark has been reached only three times in the history of the industry, and one of these occasions occurred six years ago. By all the rules of natural increase the output should have reached perhaps 50,000 cars long before this. It is necessary to look no further for proof of the impairment of the average citrus grove than that afforded by these figures. Some may see safety to the industry in the fact that our crops are not increasing more rapidly. This view would hold with more effect if light crops could be produced of superior quality and of mer-

chantable sizes, but a low yield often means inferior quality and abnormal sizes of fruit. It is not foreign to the purpose of this meeting to state that our strongest claim for a protective tariff lies in our ability under protection to supply the markets of North America with cheaper and better citrus fruits than would be supplied by foreign growers should the California industry become seriously crippled from any cause. Without this tariff protection, cheap European labor and low ocean freights would wipe out our industry, and then the foreign trade would fatten upon a rich and helpless American market and dictate the terms upon which it should feed. If we are to maintain this market ascendancy, which is beneficial to both the California grower and American consumer, we must have regular, even crops, and to produce them we must prevent the decadence or abnormal behavior of our orchards whichever it be. Especially is this necessary with our lemon groves, the products of which must meet a most continual and exacting demand, and must also suffer competition with foreign stuff far into the millions, even under the restraining influence of a heavy tariff.

GENERAL TREE CONDITIONS.

But we may look to the trees themselves, as well as to tonnage shipments, for an answer as to whether there is a decline in the orchard outlook in many places. There is a State-long complaint about the retrogression of fruit trees, both deciduous and citrus. This must not be interpreted to mean that there is the remotest danger of a collapse of our great fruit industry. On the contrary, we know that through unparalled skill in fruit marketing, through the maintenance of thousands of older citrus groves in prime condition, and through the selection of new areas suitable to these fruits, the industry will be able to maintain its supremacy and remain prosperous and stable.

It is a fact, however, that decrepit and dilapidated citrus fruit trees are found from Table Mountain in the north to San Jacinto in the south, and, then, some farther down the State. From the northern to the southern limits of citrus culture we find hardpan soils, raw-sand soils, soils impervious, impoverished and in every way unfit, yet all of which land has been struggling for two decades to produce oranges and lemons, and with the most indifferent success. Decay from active disease, collapse, and soil unfitness and decrepitude from climatic dispensations have left their mark upon the trees borne by these lands. California has been advertised indiscriminately as the home of the orange, but there are many soils and situations where the orange is never at home. However, these unfit locations produce a tonnage of poor fruit that must be disposed of, which, happily, is rapidly growing less as the trees grow older. Were we here to consider only this class of orchards it would not be worth while, for the rule of the survival of the fittest will soon work its way out without aid from the investigator for this class of orchards.

But we are here upon a serious and far-reaching inquiry. Some of the best orchards of the State are becoming unproductive, and I fear some of them are failing under the best of care. Soils heretofore fruitful, groves heretofore profitable and sections formerly rejoicing in regular crops are now suffering from decadence, or at least from stagnation, and there seems to be no means of restoration in sight. I do not believe

one of these groves has permanently lost its health or vitality, most certainly not where active disease has not affected them. But men who once were rightly considered expert orange growers are now complaining that they do not know how to meet the adverse circumstances of later cultivation. In over a hundred letters I have received approving the purposes of this conference, not one failed to recognize their importance. These growers have not lost any of their former ability, but have gained in experience and proficiency. But I fear conditions have changed faster than has grown the power to meet them successfully, and hence I have called you together to see what you think about them and to take action upon any lines you may think effective in overcoming the difficulties, if any exist. We should provide for bringing to bear the minds of those trained in original research, for the field is rich with opportunity; we should encourage those endowed with the gift of demonstration, for research has already done some things that should be proved by further trial; we should organize those who are willing and able to work out in their own orchards the application of the principles that have been, or will be established by investigation, just as a great body of growers are now working out in this community the advantages of the cyanide investigations so recently concluded. We may be sure that it will require the use of every element available to retain the quality and quantity of our citrus fruits upon the old-time basis.

CAUSES OF DECLINE.

Having considered the question as to whether there is a decadence in our citrus groves, the convention will then no doubt turn to the causes that may have produced it. In discussing the causes I assume there will arise a great diversity of opinion, and that it will be a hard task for the convention to sift out from this diversity of views a series of broad and helpful conclusions. For example, the plant breeder will hold that heredity, or inherited weakness, may be the cause of tree decline; the plant physiologist believes it to be in part due to structural imperfections, lack of affinity between the root and the scion or a mechanical fault in their union; the soil chemist will explain to you that there are some elemental deficiencies in the soil that cause the deterioration of the trees; the plant pathologist, that many forms of disease are but the expressions of neglect or other forms of disease and indications that certain poisonous principles have taken possession of the live cells of the plant and vitiated their natural functions; some will hold that overproduction of fruit will finally bring about stagnation and decay; the practical grower and scientist alike will have many explanations for the bad condition of the tree, and yet out of this divergence we may sift some valuable conclusions at this meeting, or, at least, reach the conviction that it must be done for us.

Under the present status of our knowledge of these obscure orchard troubles it may be best for every one to maintain his particular belief as to causes. But it is also expedient that many of these views should be eliminated, for where many different causes are given to account for one effect they can not all be maintained. But this elimination must be based upon conclusive testimony, and hence it would be wise to employ some one to discover all the truth that science can uncover.

This brings us to the third division of our purposes here, namely, to prepare for an investigation of all our orchard troubles through a series of scientific research. This was my contention years ago, and I now see the necessity of it more clearly than ever. I deem it my duty to ask this conference to declare in favor of such an investigation and prepare the way for its execution, and I will be greatly disappointed if some provision is not made for such an investigation before we adjourn this convention. We should remember the success of the researches in citrus fruit decay in transit, and of the researches in lemon rot and of the cyanide investigation. To have a similar examination of the cultural end of the citrus fruit business would be as wise as it is necessary.

You have listened with some patience to the foregoing statements, and I will conclude with a brief discussion of our fourth purpose. The "average truth," as Mr. Woodford puts it, has never been told concerning the citrus fruit business, at least it has not been told from the house-tops. The roseate end of it has been too much proclaimed. The time has come when the average truth must be told in emphatic language, for the country must be made to understand that all is not gold that hangs from the boughs of the orange tree; that it is only gold when every function of the soil and tree is working, and that it is a man's job to keep them working; that it is only profits when every cog of the marketing machinery is fitted to its duty and oiled with coöperative spirit; and that the brake must be kept upon every parasitic and perdatory influence to keep them from running away with the whole works. The marketing machinery needs little attention. The insect problem and the care of the fruit in transit have been pretty thoroughly and successfully exploited. But let us discuss at the close of the meeting something of the powers and influences that deplete the business before the fruit has been produced and brought to sale. Lest we forget that we have been too boastful for the good of the industry, let's tell the "average truth."

Your citrus acreage will be assessed heavily enough and you will get a raise from the State Board of Equalization often enough without making the public believe there's affluence in every acre of orange grove. Your unbounded energy and enterprise will maintain land values without aid from the Ananias Club. When the fruit tariff comes up again for adjustment, it can be done more justly to your interests if we eliminate the untypical and often untruthful statements of extraordinary orchard returns. When the railroads attempt to absorb your tariff advantages, or raise your freight and refrigeration rates, it does not make them less covetous to show them only the bright side of the fruit business. When the Interstate Commerce Commission undertakes to stay the hand of the Transcontinental Freight Bureau it is not helpful to the grower's cause to have exaggerated crop records and imaginative account sales in every pigeonhole of the bureau.

In conclusion, I ask the members of this convention to give their best thought and judgment to the work before us. Let us be determined to meet the difficulties with energy and understanding, and all unite in seeking a solution of every orchard trouble, of every impediment that may hinder the perfect development of the greatest fruit industry in the greatest fruit-growing State in the Union. [Applause.]

PRESIDENT JEFFREY. The next thing on the program, ladies and gentlemen, will be a response to this address by Mr. P. J. Dreher, of Pomona. [Applause.]

MR. DREHER. *Mr. President, Ladies and Gentlemen:* We have had presented to us a most remarkable statement of the facts that confront you. I think that everything that Mr. Jeffrey says in his paper should be done, should be regarded, and I mistake the temper of this convention and the intelligence of this people if they do not go to work at this thing with a will that will leave no doubt as to the success of the future. I think the time has come when a more definite, scientific, intelligent basis must be used in order that the prosperity of the industry be prolonged and continued without some setback. You have now one hundred and twenty-five millions invested in orange groves and lemon groves of this State, and you are not getting the returns that you ought to get for the money invested, if you take into consideration depreciation of the plant, a thing which has been heretofore neglected by all people who have furnished certificates as to the profits of orange growing. In the controversy we have just had before the Interstate Commerce Commission, one of the items of great value is the depreciation of plant. Have we considered that in any estimates we have made? No. The icing plant claimed it deteriorated ten per cent; the railroad company claimed a deterioration in the refrigerating cars; they bring everything against you as an item of deterioration. You have no way of knowing what the deterioration may be. You don't know what trees twenty-five years old now will bear in five years, a larger or smaller crop, or whether they will bear at all. This depreciation should be fixed more definitely than we have been able to fix it with the haphazard way we have, and it can only be settled by scientific investigation. It can only be obtained either through the Government of the United States or the government of this State. Just think of it! One hundred and twenty-five millions of dollars investment in the industry that will be worth less to-morrow than to-day because we have not scientific investigation! You are confronted with the statement that you are having great revenue-producing properties when the tax assessor comes around. The railroads confront you with the fact that you are making a great deal of money. As our chairman says, they have got it pigeonholed, and in most cases, probably, the returns are exaggerated. Now, why should we allow such a condition to continue? In going before the Tariff Commission, as you will have to go soon, you must present facts to show them that you are entitled to the protection they now give you; otherwise, the clamor is, from the importer, from the speculator, and even from the misled and misinformed consumer, that you tax them too high for your fruit, yet you would be paying an enormous burden to the carrier and have unjust protection, and the land would be flooded with foreign fruits, which can be produced with cheaper labor, cheaper transportation, and where would the consumer be? He does not see that, but you have got to bring the facts before the consumer and before the commission, that things are not all as golden as they appear to be. When you compete with the railroad, when you are confronted with rates, the same thing arises, and the fact is, that the railroad rates to-day are made upon what the traffic will bear. They have not been able to produce definite

information of what it cost to haul a car load of oranges across the continent, and the deduction must be that they have charged all the traffic would bear. In fact, Mr. Leeds said, only a few days ago, when he was asked what they would charge if they precooled the fruit and iced it, that they would charge what they thought it was worth to the shipper. You must, by scientific investigation, determine that there is a charge for depreciation as you can present that intelligently both to the carriers and the Tariff Commission and to your assessor. I can not too strongly urge this matter of necessity of presenting it to the carriers, because you are paying enormous amounts, and while we have done well in preventing the increase of the freight rate on oranges and lemons, it is all in abeyance and the carrier now is taking another tack, another indirect increase, and we will probably have to fight the same batle next year. You should establish more definite value to the depreciation, which I know this convention will do, and pass some resolutions or get up some united action by which they will interest the United States Government or the government of this State to make such scientific investigations as only can be made by the Government.

I am not going to take any more of your time because I have nothing more to say. You must go at this subject with your whole heart and with a will and a determination to succeed and find out what you want and ask for it. [Applause.]

The convention took a recess until one o'clock p. m.

AFTERNOON SESSION.

PRESIDENT JEFFREY. The convention will please come to order. The members of the Committee on Order of Business were delayed in getting their lunch, so we will have to wait awhile for their report. The next part of the program is a report from the county horticultural commissioners of the seven citrus counties as to the actual condition of the trees. Is the Los Angeles County Commission ready to report?

MR. STRONG. *Mr. Chairman, Ladies and Gentlemen:* About a month ago the Commissioner, Mr. Meserve, asked each of the inspectors of Los Angeles county to hand in a report on orchard conditions in their separate districts, and that was handed in last week. I never have seen it, so I can't tell you anything about it. It was to be here, and probably will be here to-morrow. Of course, our orchard conditions are different in each locality. While in some localities the conditions are good, in other localities they are not good.

PRESIDENT JEFFREY. We will now hear from Mr. Pease.

MR. PEASE. *Mr. President, Ladies and Gentlemen:* Speaking for San Bernardino county, I can say that the general condition of the citrus orchard is good. Like all other counties, we have some reports occasionally of trees that are in bad shape, but upon looking them over I find, in the majority of instances, it is to my mind caused by con-

ditions that can be eliminated or improved. For instance, we have places where people were talking about decadence of orange trees. I know of one locality where a few seedling orange trees and Eureka lemons are dying. The cause has been investigated, both by the scientific men of the University and by myself, and it is the consensus of opinion that the trees were planted from 8 to 12 inches too deep, in a heavy soil, consequently they have become rotted. Other causes might be attributed, largely to a lack of fertilizing in some instances and lack of irrigation. Sometimes it is due to a heavy frost. Sometimes when trees in the older localities have been, as we say, hit very severely by the frost, it takes one or two years to recover. Again, some trees, it is claimed by people, and maybe their reasons given are good, that trees might be budded on the wrong kind of stock. It is generally conceded that lemon stock is very poor stock to bud oranges or lemons on to. I have seen instances where trees appear to be getting mottled leaf and people have tried with fertilizers to change the color and get the rich color desired, but with fertilizers they did not get it. I know of one man in my county who carefully dug down close to the trees among the roots, and dug as deep as he dared to dig, and he applied a little thoroughly rotted manure to those trees and he eliminated the mottled leaf entirely. The general condition of the trees is good, and the outlook is for a much larger crop than we have had in a good many years.

PRESIDENT JEFFREY. Do you claim that in San Bernardino and Redlands the orchards are doing their duty like they used to twelve years ago?

MR. PEASE. I think they look for a larger output this year than we ever had before. There are orchards where the output is poor. I have seen decadence of the trees in seedling trees; one orchard was not bearing anywhere near a full crop and in another locality where the trees are of the same age they are still bearing a good crop. I think that is all I have to say. [Applause.]

PRESIDENT JEFFREY. We will now hear from Mr. Cundiff.

MR. CUNDIFF. *Mr. Chairman, Ladies and Gentlemen:* In Riverside county the present crop will be very much better than we had last year. Our old groves are not bearing what they should and what they did eight or ten years ago, but there is some improvement, enough, at least, to make us a little bit optimistic in regard to the future of our old groves. We have in our county, as near as we can get at it from our assessor's books, about 24,000 acres in citrus fruits. I think this season will see a planting of perhaps 1,000 or 1,200 acres more. While we will have more fruit than we have had for a number of years it is not to be credited to the old groves, but more directly to the new groves that are coming into bearing.

A MEMBER. I should like to ask what you mean by old trees?

MR. CUNDIFF. Our main trouble, of course, is with the navel; that is because it predominates. I should call a tree old after it is about fifteen or sixteen years of age. Then the deterioration has usually shown itself, commencing from the fifteenth year. We have some in a portion of Riverside that are over thirty years of age.

PRESIDENT JEFFREY. Mr. Roy Bishop, of Orange county.

MR. BISHOP. The conditions in Orange county are very good indeed. There is an extremely large planting of young trees, lemons

and oranges both, the Valencia predominating, and in the older Valencia orchards they are still bearing. In the case of the navels there is a slight decrease in many of the orchards that are over fifteen years of age and in some of the seedling orchards. The condition regarding insect pests is being materially improved. We have something over fifteen large fumigating outfits. The trees, I think, in some instances, show a lack of fertilization, but deterioration on good soil, in the case of the Valencia, is not noticeable. In the case of the navel it is noticeable only upon the thinner soils and not upon the most fertile ones. In seedling orchards over thirty years old, some are not bearing their full crop, but on the other hand, there are a few exceptions of trees that are in elegant condition. The general citrus condition of Orange county to-day is better than it was two years ago, and I think that is largely due to fighting insect pests more than they did at that time. [Applause.]

PRESIDENT JEFFREY. Mr. O. E. Essig, of Ventura county.

MR. ESSIG. *Mr. Chairman, Ladies and Gentlemen:* To speak right to the question, we simply must consider this, as I was notified: Is there any appreciable decadence in orchards which are well cultivated? In our county I can emphatically answer, no. After making a complete canvass and having been personally in every orchard in Ventura county, we find conditions to-day very favorable. But it does not mean that the general decadence throughout California can always correspond to Ventura county, for two reasons. Ventura county is a comparatively young county in citrus culture. There are probably more young orchards going out to-day in this county than any other county of its size. We have no old groves, except one or two, which are from thirty-two to thirty-five years old, and these trees are doing first-class work. Last year, in Mr. Blanchard's orchard, we found that his orange crop kept better than ever before and producing all the time a normal crop. This orchard is approximately thirty-five years old. He has also a lemon orchard which was budded on to old orange stock, and this looks better this year than before, probably due to the face that certain insect pests were cleaned out. Take the Piru district, which is farthest inland and would correspond with San Bernardino and Riverside for climate and soil. We have there one orchard thirty-five or thirty-six years old which is in normal condition and bearing well. A lemon and an orange orchard are twenty-three years old, and these trees promise better crops this year than ever before. Now, we have orchards which do not look well and we attribute that, not to any unknown, mysterious disease which we do not know of, but solely to lack of proper fertilization, cultivation, and irrigation, and probably in every locality we find this is the case. That is briefly the condition in Ventura county. [Applause.]

PRESIDENT JEFFREY. Mr. Beers, of Santa Barbara.

MR. BEERS. *Mr. Chairman, Ladies and Gentlemen:* There is a very small decadence in Santa Barbara county in the citrus industry, not to exceed eight per cent. It is due to one of three things. Some of our ranches have been leased out for four or five years while the owners have been in Europe. Those ranches have suffered from lack of attention. We have gum disease attacking some of the trees in the district, and we have a mysterious root disease that we do not know the name

of—a disease that attacks the roots in the fibrous young live growing section of the root and gradually approaching the tree where discovered, and the root is treated. We have a number of trees that have been through this process that are now bearing thrifty crops. We have, in Santa Barbara county, probably the oldest commercial orchard in the State of California. That orchard to-day has the most thrifty and generous supply of fruit on it of an excellent quality that it has ever borne. The orchard is about thirty-eight years old. [Applause.]

PRESIDENT JEFFREY. Mr. Stuart, of San Diego county.

MR. STUART. We have a good many orchards down our way that run from eighteen to twenty-six years old, and where the soil conditions are good and the man knows how to take care of an orchard, there has been no deterioration. There has been deterioration in the acreage and in the output of that county, but that has been largely due to planting on poor soil, and then, unfortunately, a few years ago, we were one of the counties that it didn't rain on for about six years. But where the old orchards are well taken care of I don't see any necessity in that county for the people to worry about any unknown disease. [Applause.]

PRESIDENT JEFFREY. This little introductory was intended just as a sketch. I am afraid we are up against the old proposition, though—afraid of a confession. I would rather have heard Mr. Pease and Mr. Cundiff and all my old friends get up and tell just exactly what some of those orchards look like. Tulare county is a very young citrus county. Mr. Schultz, of that county, wrote me there was great need of something being done up there, and I have hundreds of letters, perhaps fifty from men here, stating that there is something wrong and we must get together and investigate these things, but you would hardly suspect it from these reports. They are the health officers of the county. They are doing their part, but there are things that they can not reach. They are fighting the insects in good shape. You know what Mr. Pease is doing over here; but I don't believe they have told us anything about the sick trees.

MR. DREHER. If they want to see some pretty sick trees I can show them here within a few miles, trees twenty-five years of age that are dying, and have had the best of care. The gentleman is a small grower and has nursed his trees like he would children.

PRESIDENT JEFFREY. Is the Committee on Order of Business ready to report?

MR. CHIPPENDALE. *Ladies and Gentlemen:* The following is the program which the committee recommends for your adoption:

ORDER OF BUSINESS.

Your committee respectfully recommend that the convention, after the introductory proceedings, consider:

1. Whether there is a considerable decline in the production of the citrus groves of the State.
2. If so determined, to assemble at this conference for publication all the information, discussion, and experience possible as to the causes and effects of such decline.
3. To take steps to produce a broad and comprehensive investigation of the adverse influences that may be operating in our citrus orchards.
4. To make specific and unmistakable declarations that shall set forth the citrus fruit business in its true light, giving the public, and also the officials connected in any way with the economics of the citrus fruit trade, a candid statement of both the favorable and the unfavorable conditions of the industry.

5. The committee recommends that the discussions be confined clearly to the point under consideration in each case, and that all immaterial and purely local matters be left out of consideration.

6. The committee further recommends that all discussions purely argumentative be eliminated.

7. That every delegate be urged to take part, but to give his ideas in short, terse form, and to the point at issue.

8. That speeches, discussions, and statements be limited to ten minutes each, unless time is extended by vote of the convention, excepting those presenting formal papers or addresses.

9. We also recommend that the Committee on Resolutions, if necessary, have their resolutions ready to present at the close of each subject, so the business of the convention may be carried through with dispatch.

WM. CHIPPENDALE,
EDGAR A. WRIGHT,
WM. C. FULLER,
Committee.

MR. CHIPPENDALE. I would move the adoption of that order of business, gentlemen.

The motion was duly seconded.

A motion was made to amend by limiting speeches to five minutes instead of ten, as reported, which motion unanimously prevailed, and, as amended, the report of the committee was adopted.

PRESIDENT JEFFREY. The next thing on the program is "Botanic View of the Orange," by S. B. Parish, of San Bernardino. I will say that Mr. Parish is a contemporary of Asa Gray, the greatest botanist America ever produced. Even in his older age, he has prepared us, in the form of a letter to be read before this convention, something that becomes very suggestive; and Mr. Ernest Braunton, another botanist, will read that paper to the convention.

Mr. Braunton read the following letter:

BOTANIC VIEW OF THE ORANGE.

By S. B. PARISH, Systematic Botanist, San Bernardino, Cal.

Mr. J. W. Jeffrey, State Commissioner of Horticulture, Sacramento, Cal.

It is with regret that I find that my engagement will not permit me to accept your invitation to take part in the conference you have called to meet at Pomona to discuss the condition of the orange orchards of the State. The matter, however, appears to me to be one that should be considered primarily by practical horticulturists, rather than by botanists.

If orange groves are deteriorating it must first be ascertained if there are not reasons to be found in unsuitable or insufficient cultivation, in irrigation or in soil fertilization. Soils may be unfit, either in themselves, or by reason of a hardpan, which may prove injurious when reached by the roots. The immediate and secondary effects of frosts and cold must be considered. Again, local conditions may in some cases afford an ample explanation, as in the "cement zone" near Colton, where the opaque incrustation deposited on the leaves prevents them from manufacturing sufficient plant food for the trees, and is the evident and certain cause of their distress.

If, after these accountable cultural and local causes have been eliminated, there is found yet to remain a considerable number of groves, well situated and well cared for, which are yet deteriorating, the cause might be reasonably considered to lie in the nature of the orange tree

itself. Such questions would then come up as to the age at which trees show deterioration, and the exact way in which they show it; the differences, if any, manifested by different varieties and by different stocks. It is only when in possession of exact information on points such as these that a student of plant physiology would have the necessary basis for investigation.

But a few general considerations may not be out of place. The orange tree is no exception to the universal law that all organizations have their periods of youth, maturity and decline which may be measured by days or by centuries. Good authorities place the productive period of the orchards in the orange growing regions of Europe at from fifty to eighty years, so that it is hardly probable that even the oldest of our trees have reached an age at which their productivity would materially diminish. Again, it is the fact, I think, that a budded or grafted tree is usually shorter-lived than a seedling. This is markedly the case with the peach and the plum. Doubtless varieties might be selected and propagated which possessed the property of attaining a great age of productivity, but our choice oranges have been selected for the quality of their fruit, without inquiry as to their longevity. An investigation of the behavior in this respect of different varieties might prove of value.

It must also be remembered that our most valued oranges and lemons are, from a physiological point of view, monstrosities. They are abnormal because they lack seeds, and they are seedless because the flower is incapable of being fertilized. The rule is, that unfertilized flowers produce no fruit, or only abortive fruit. It is well known that some varieties of pears are very unproductive unless grown with others that supply a more potent pollen, which, carried by bees, fertilizes the varieties whose own pollen is imperfect. In the peach unfertilized flowers either fall off, or produce small, abortive fruit. The Zante grape is incapable of self-fertilization, and produces the little seedless "currants" of commerce, but if fertilized by the pollen of other varieties bears a seeded berry larger than the finest Muscat. Now, while our seedless citrus fruits appear to be exceptions to this rule, may we not, from its operation, expect to find at least some uncertainty in their productiveness.

This might especially be suspected to be the case with the navel orange, which, in addition to its seedlessness, is doubly an abnormal fruit because it is, in reality, a consolidation of two oranges, one rudimentary, situated at the navel end of the other, and, in fact, causing the so-called navel orifice. Usually it consists of some vestiges of epidermis within the navel opening, but its real character is very evident in some of the "freaks," when the imperfect secondary orange may be often found exterior to the principal one, and may even contain some pulp.

It is believed, I understand, by some orchardists that the Washington navel tree degenerates into the inferior Australian navel. Assuming that these are two actually distinct varieties, and that one is not giving the latter name to coarse grades of the former fruit, it would require very conclusive evidence, carefully sifted for the elimination of error, to convince a botanist that such degeneration actually occurs, since it is quite contrary to the facts in plant life with which he is

familiar. Evolution, whether by slow selection or by sudden mutation, does not change the varietal character of an individual by reason of its age or other condition. These may cause a plant to produce inferior fruit, but not fruit of a different variety. The production of varieties is from an offspring which exhibits differences distinguishing it from its parents. The idea that an orange of one kind degenerates into another, like the old belief that wheat degenerates into chess or cheat, must be the result of inexact observation.

The orange growers of California are an unusually intelligent class of agriculturists, and we may be confident that their discussions at the Pomona meeting will supply us with much valuable information concerning the character of the orange tree, and the best conditions for its successful culture.

PRESIDENT JEFFREY. If any one would like to discuss this paper we will try and wedge in a little discussion as we go. Does any one wish to add anything to the paper?

MR. BEERS. I would like to inquire if it is observed that seedling fruit or other fruits than the navel ever bear sports of the navel form?

MR. KOETHEN. It is undoubtedly a fact that all the varieties of orange bear more or less navel fruit. Especially is that the case with the blood orange. It is a common belief that they come from the navel; I don't think that is the case. I believe Mr. Parish has struck an important fact there, that many of our navels, so-called Australians, are really only sports from real navel trees. The large percentage of nursery trees that have been rebudded into Washington navels, supposedly Australian, originally had their origin in sports.

MR. FULLER. I am perfectly satisfied that the Australian type of navels is a deterioration from the Washington type or the Riverside type of navel. From my view of the Washington navel in Florida, which have almost all gone into the Australian type of navel, I say the facts, as far as I can see them, outside of the law of theoretical botany, would prove to me that the navel puts on as one of its sports the Australian type of orange.

MR. DEWEY. After about eighteen years of actual experience I have found that there is a deterioration of the navel tree. That tree may be a good tree for ten or fifteen years, one of the very best. All at once we find that it has deteriorated into the Australian. After deterioration absolutely takes place there is no way of reclaiming that tree (illustrating at blackboard). This represents the form of the seedling tree in Bahia, Brazil. This represents the navel sport. Now, we will erase that sport. Here we have the navel tree. Any navel tree, I care not where it is from, unless you remove those two it will deteriorate. Now, we will say there is a nursery stock. It is immaterial whether that tree is headed that high or that high. If that is one continuous growth from the bud to that crown, it is a tree that will deteriorate in early life. If that tree is a two-year-old bud on a four-year-old root, naturally that is removed to there (illustrating), when we come to set that tree, in order to balance up for these little roots that have been cut off. Wherever a limb has been made out of suckerous growth it deteriorates in early life. If you find that that tree has made from the bud a growth one third way or one half way

to the crown, denoting two growths or three growths; if you have three separate growths in that tree you will have a good tree, but if that tree runs from the bud to that crown without making a second growth I advise you to leave it alone.

A MEMBER. Your idea is that a retarded growth is going to make it a good navel tree?

MR. DEWEY. Yes, sir. A suckerous tree will deteriorate in early life. These limbs come out originally and make your tree. The limbs must turn down right from youth. We will find that after the orchardist sets his tree little shoots will start all up the body of the tree and some of them come up here and usually went around here. You pull off some of the head of that tree and you say, "Well, I have pulled these suckers off; that will be all right; that will fill out this top." The result is that these cut off come up here. This wood is drowned out. Your sucker has a top and after the first signs of deterioration, it may be in four or five years and may be in ten years—the first signs of it is a line in the top. That gives you warning. When you see that line take that sucker out. The second year it takes the line this way and the third year this way, and there is your Australian tree left, and there is no other way of getting out of it. [Applause.]

MR. HAMBURG. I believe the cause of the Australian navel is the man that takes the bud. If you take buds from the sucker of a tree you are going to have Australian navels. I can grow a tree and make a dozen growths and can not make four feet, or I can grow it in one year just by cultivation and irrigation. If you irrigate your trees thoroughly and cultivate them they will continue to grow. If you give them a little water they will go dormant a little bit and then stop growing. I think it is altogether in selecting buds. As far as Australian or sucker growth of trees, if you select the buds from them I think you are going to have Australian.

PRESIDENT JEFFREY. We are not trying to decide here whether a Washington navel will become an Australian or not.

MR. BOYD. I believe it is generally conceded by those who know, that the Australian navel and the Riverside or Washington navel are both from the same origin. I have talked with Australians and they tell me that it was when vessels took six or seven months to go to Australia, they would call at Bahia, on the coast of Brazil, and get the buds, but they are distinct now. How it is I don't know, but they are both from the same origin, that is, from Bahia, in Brazil.

PRESIDENT JEFFREY. We are not trying to settle the origin of the two trees. We know that we do not want a bad orange tree. Now, Mr. Maskew, as secretary, will read a paper written by Mr. William Wood, of Whittier, upon seed selection.

Mr. Maskew read Mr. Wood's paper, as follows:

SELECTION OF SEED AN IMPORTANT FACTOR IN LAYING THE FOUNDATION FOR A CITRUS ORCHARD.

By WILLIAM WOOD, State Quarantine Inspector, Whittier.

It has been said by many growers who have observed the growth and fruitfulness of citrus orchards in southern California in the past twenty-five or thirty years, that citrus orchards of the more recent planting do not thrive and yield as good crops as did orchards of the first planting—age of orchards being equal; that citrus trees of the first planting were not nearly as subject to disease as they have been in the later planted orchards; that in orchards of the more recent planting, many trees begin to decline and the fruit to deteriorate at a much earlier age than did the first orchards; and that this decline and deterioration has been quite noticeable in many of the later planted orchards where the natural conditions were apparently good, and in many of these orchards the care has been better than was given the earlier planted orchards. If these statements are true, what has brought about so radical a change? I do not think such a change should be laid to any one condition. It must be remembered that citrus orchards in the past thirty years have been planted on most all kinds of lands, often where the conditions were very unfavorable, such as heavy soils underlaid with clay or hardpan and with poor drainage; soils underlaid with sand or poor gravel; soils that have been cropped and impoverished with wheat, corn, barley, etc.; soils that never had sufficient of the needed elements to sustain an orchard for a great length of time. Improper irrigation, such as holding water in basins; allowing the soil to bake under and about the trees; allowing the trees to suffer for moisture for a long time and then forcing them with water and fertilizer. Under such treatment I have known orchards where many trees soon develop gum disease.

All these are conditions unfavorable to the healthfulness of the orchard trees, but back of all this, may there not have been a hereditary weakness transmitted from the parent tree, that has made a large per cent of the trees susceptible to such diseases as we find common in the orchards of to-day, and must we not look for some of the possibilities of improvement from carefully selected seed?

Under the conditions I have named, we often find good healthy trees yielding good crops of fruit, while the nearest trees growing under the same condition are weak, diseased, dead or dying. In such a case it would seem that some trees are weakly constituted and are more susceptible to disease than others. Now, when we consider what kind of seed stock trees are grown from, is it any wonder to you why we have so much weakness and disease in many of our orchards?

In laying the foundation for a citrus orchard, we can not place too much stress upon the importance of the careful selection of seed. I believe the seed should be one of the first considerations. If we save seed from fruit known to have grown on good, old, healthy seedling trees, we may reasonably expect much stronger, healthier, and longer-lived citrus orchards as the result. It may be said that there is no certainty that the trees will all be like the parent trees because of the cross-pollenization. From my own observation I have found that this

is only true to a very slight degree and that seedling orange trees produce after their kind almost invariably.

Let us compare the foundation we have used in the past twenty-five years with that known to have been used in the first orchards planted in California. I have not much data as to what kind of orange trees the seed plants were grown from, but I have good reason to believe that the seed did not come from the poorest fruit that grew, as has been the case in the later planted orchards of California; but rather from decayed oranges such as were found in the markets of San Francisco, which was probably the best fruit grown in the Hawaiian Islands, or the countries from which the fruit came.

I think that every one who has been connected with the growing of orange seed-bed plants will agree with me that all sweet orange stock grown in the past twenty-five or thirty years have been propagated from a very large per cent of the poorest of seed that could be had—from the poorest seedlings, budded fruit, and a large portion from sick and weak trees. I think I can make myself better understood by explaining how orange seed is obtained.

In the later years, nearly all orange seed has been gotten from cull seedlings or any oranges that have seed in them, such as are thrown out at the packing houses for culls. A large per cent of these culls come from sick, diseased, weak, and dwarfy trees. If there are any such in the orchards, the fruit almost invariably is picked from them and brought to the packing houses with the best. When the fruit is sorted, a very large portion of this fruit from the sick or diseased trees is thrown into the culls, consequently a large per cent of the seed comes from the very poorest and weakest trees in the orchard.

Now, if the weakness is hereditary, and I believe it is, what may we expect if we go on planting trees from such stock? Who of you would knowingly plant the poorest seed of grain, potatoes, corn, or anything except oranges? Why, then, should we not be just as particular, and more so, in selecting orange seed?

It has been said by many California growers that sour stock is immune from gum and foot root disease. From my own observation I have found this not to be the case. I have seen a few cases where sour stock gummed quite badly. I have also had quite a bad case of foot rot in my seed-bed nursery. In this case the condition was caused by heavy soil and too much water, and the rot affected both sour and sweet stock the same.

In the past three or four years seed of the wild sour orange trees of Florida has become generally used by the nurserymen of California.

I understand the demand for this seed has been so great that all of this kind of fruit has been used for seed. Sour stock as a healthy long-lived stock upon which to bud has been very highly recommended by Florida growers.

I believe this stock is much less subject to gum and root rot diseases than such sweet stock as we have been using, possibly because the seed has been saved from all of the fruit and not from all the poorest as has been the case with the sweet stock seed used.

I believe if all of our seed were saved from the best trees instead of the poorest, we would have a much larger per cent of good, healthy, long-lived trees. [Applause.]

PRESIDENT JEFFREY. Is there to be any discussion upon Mr. Wood's paper?

MR. DEWEY. Mr. Chairman, I will take the same stand that he takes on the seed proposition. I believe the sour seed is most preferable. I believe the tap root from a sour seedling goes deeper in the ground, and I believe it would be better if all of us used the sour stock instead of the sweet stock.

PRESIDENT JEFFREY. I would like to say, in behalf of the office which I represent, that the reason we passed a special modification of the Florida quarantine, away along in the spring, was to allow the sour orange seed to be introduced into California, on the plea from the growers that it was a more hardy variety than the sweet seed gathered here in southern California. So we made a special order allowing that seed to be shipped into the State if it was shipped to the horticultural commissioners of the county and shipped in tight cases and there examined and fumigated by the commissioners. The reason of this was the supposition on the part of the growers that it was more immune from gum disease and perhaps produced a hardier tree. What effect it will have on the quality of the fruit in the future somebody will have to tell us.

MR. MASKEW. Gentlemen, it appealed to me, in reading the paper, that the point Mr. Wood desired to make was that the demand for Florida sour seed has grown so great that they take all the sour seed, good, bad and indifferent. I think Mr. Wood is present, and he ought to clear up that point.

PRESIDENT JEFFREY. Mr. Wood, did you make the point that they gathered all of the fruit from the tree for sour seed in Florida?

MR. WOOD. Yes, sir. I believe you could get poor seed or weak seed from sour seed as well as sweet seed.

MR. MASKEW. Is there any possible way of determining the seed, whether it is from good or from inferior fruit?

MR. WOOD. There is no way to determine the seed, but it is to determine the tree.

MR. BLANCHARD. The seed of the orange does influence the character of the orange. My orchard is an old seedling orchard, grown from the seed of Havana oranges. My neighbor planted some of those trees. He planted also some trees raised from the seed of Los Angeles oranges. He told me voluntarily that the first class of trees, that is, the trees raised from the seed of Havana oranges, were better oranges than the oranges that grow from the seed that came from Los Angeles.

MR. COLLINS. I would like to ask Mr. Wood if he has ever noticed any difference between the growth of the sour stock and the sweet scion; in other words, whether they keep even or whether the sweet scion will outgrow in growth the sour stock?

MR. WOOD. I have noticed that lately. Take yearling buds on the two and three-year-old tree; the sour stock will outgrow the sweet scion, particularly the limbs.

MR. COLLINS. I noticed in older orchards the sweet scion had outgrown in growth the sour stock.

PRESIDENT JEFFREY. Would that have a tendency to cause the tree to deteriorate?

MR. COLLINS. We assume it has; we don't know.

MR. BOYD. As one of the oldest growers in California, I can speak of a selection of seed in the early days. The seed in the early days was always selected, and always the best to be got. In fact, you could not get any bad seed; there were no packing houses and no culls. The greatest shipment came from abroad. Thomas Kelly and others imported 200 barrels of oranges to make seed of. That was supposed to be enormous.

PRESIDENT JEFFREY. Ladies and gentlemen, I take pleasure in introducing Mr. Charles R. Paine. Mr. Paine's article is "Renovation of Orange Trees by Systematic Pruning."

Mr. Paine prefaced the reading of his paper by remarks illustrated by charts. His paper is as follows:

RENOVATION OF THE ORANGE TREE BY SYSTEMATIC PRUNING.

By C. R. PAINE of Crafton, Cal.

The observer of plant growth will note that, in the ordering of nature, leaves are so arranged as to give the greatest possible exposure to sunlight and air. A growing tree of any kind, in a state of vigor, has the most active growth in the terminals of its branches, the top branches increasing faster, until the tree attains its normal height, while the lower branches, especially when trees are crowded, gradually weaken and die. This is particularly noticeable in forest growth, where the fir tree bears its cones only on the topmost branches, and in pines, where the branches higher up produce their cones. Among the multitudinous blossoms of the orange tree, on the new spring growth, it can be fairly well predicted which particular blossom will mature to fruit, for it is at the very ends where most plant food is being made. The law, that favoring conditions of growth are found in exposure, universally applies. In cultural conditions, where the orchardist is in control, it is policy, therefore, to secure the largest possible number of such points of life activity in obedience to such law.

A young orange tree and one approaching the maturing stage can do fairly well without asistance in modifying its form, but in the latter, the maturing stage, it is time to interfere to secure the ultimate health of the tree and future profit.

In the orange tree, the vigor of its growth under usual stimulating conditions, a heavy foliage and fruitage is produced, with the result that branches above smother those below, shutting out from them the normal supply of air and light, without which they suffer and ultimately perish. While the tree is young, and not of large circumference, these influences are so near to the poorly situated leaves, that their suffering is less and little noticeable; but, when the tree becomes of larger proportions, it is inevitable, that, when untended, the smothered branches become of little value and finally die, in which process of gradual decadence they are rarely of use themselves and become hindrances to the more profitable parts of the tree.

The plain inference from these conditions, if the grower desires to profit by obedience to natural law, though he may have no special knowledge of plant physiology, as a science, is to cut out such failing branches. The sap flow to them is lessening daily; the bark color is darkening; the

master branch becomes bright and vigorous and the flow of the life fluid makes active growth but an inch or so along the old channels.

This should be done as soon as the weakened state appears, for when they are dead and dry they have little or no effect in shading or hindering air circulation, but offer mechanical obstruction only. If the work of removal is done while such braches are still green, the beneficial effect is apparent to the good branches remaining, which get the needed exposure. The good branches thus relieved are, however, subject to the incubus of one or more lively shoots growing upon them, which must be taken off before they do mischief to their mother branch, for their upright growth gives them advantage of position and they would dominate the branch that is best for fruiting. If, however, they are not aspiring, but modest fruiting growth, they may be considered as part of the principal branch. Not so, however, those strong, rank-growing suckers that issue from the trunk, or on main limbs near their junction with the trunk and shoot upward with an intensity of energy as if to become the whole tree. They would, indeed, if unmolested, change the character of the tree in its regular habits of moderate growth, accompanied by the production of the finest quality of fruit, which should be the result of cultural conditions. These exuberant parts are not needed for tree renewal, unless one is willing to give up direction of growth and submit to the wild ways of nature. Cut off, then, these intruders, before they suppress the activities of the parts they grow upon, which bear the nobler fruit, and which in time they would supplant.

When a large orange tree is made clean on the inside, that is, hollowed out by the process of breaking and cutting out the dead twigs and branches, it is obvious that little or no good is done, so far as providing for access of light and air; neither does good, but rather harm ensue from the practice of clipping the outer surface of the tree unless a more shapely appearance is considered the object, for the head of the tree is closed by the succeding growth to important natural influences. Of course, there can be no objecton to cutting off large protruding parts, or dangling limbs.

Each limb, so treated, completes the pruning of the tree at this stage of its life, provided suckers have been kept out, and cross limbs eliminated from the beginning.

The work thus far described, keeps the tree of middle age, in good condition, in constant thriftiness, because neither the younger parts, nor the used-up older have been permitted to interfere with the best parts.

Then there comes a time when the tree has the appearance of age, the signs of which are enfeebled growth of the ends of the limbs, especially of those directed upward. This is shown both in the yellow and smaller foliage and in the inferior quality of the fruit. The leaves, when not wholly yellow, are green only in the veins, or for a little distance on either side. Life forces persist longer in the veins because they have a fibrous, more woody structure than other parts of the leaf blade. This small proportion of the whole leaf surface having green parts, chloroplasts, which alone have the power, under the influence of sunlight, of food manufacture, contributes very materially to starvation of the tree. This may go on so far that, in the natural course of

things, the whole exterior of the tree is surprisingly thinned by lack of good growth. It is surely an alarming state of decadence.

Among the causes of the failing condition of the outer parts of the limbs are soil washing by concentrated rainfall or careless irrigation, or lack of sufficient humus material. These causes we may know. Others exist, like unsuitable proportions and quantities of fertilizing material, which have to be guessed at. So, of soil tending, which may have been too deep and too frequent in light soils, resulting in burning out the humus and too shallow or too infrequent or untimely cultivation in heavy soils. Whatever the cause which our scientists and practical orchardists must unitedly study and work out, a remedy, for a time at least, is naturally found in resorting to a more robust location of growing and fruiting points upon the still vigorous larger parts within the head of the tree. The tree has the opportunity for revival by the openness brought about by the exhausted and feeble growth of the outer parts. Upon these larger parts of the limbs, and from the trunk appear, under what must be favoring conditions, new shoots with large leaves issuing from newly-formed fruiting wood. The tree is then made up of two quite opposite features, a healthy, vigorous interior, productive of merchantable fruit, the outside portions of the same limbs, bearing some fruit of inferior grade; and other parts of the same being useless brush of which the neglected tree can not rid itself.

The work described, as belonging to the first stage of pruning, postpones the deterioration of the branches, if it has been begun in season, and been periodically performed by intelligent labor. But when this serious alteration in the condition of the tree, now so prevalent, is coming on or has been reached, a new practice becomes necessary, which is based on the same elementary principle as the first; namely, free access of atmospheric influences.

It may be said, by the way, that basic principles are the only reasons entitled to respect as foundations for methods of work.

The failing top branches afford a vantage ground, incomparably superior to the side branches, where the first work is done, for the admission of air-contained food—carbon dioxide—and light unhindered, direct from the sky above, which is the agent for its utilization to provide the carbohydrates, sugar and starch.

Limbs, though large, that constitute the upright part of the tree, and branches that have formed an angle with them, may be freely removed, even though somewhat fruitful. The open space resulting from this seemingly severe pruning, though an irregular space, may be likened to an inverted cone.

When the cuts are made and the old limbs tossed out, the barren space that meets the eye seems like a waste, but it is, in reality, the battle-ground whereon the tree will regain new life. The proof that such is the case begins to come at once, for it is in the spring when the crop is off that the opening is made. Within the tree, what seems almost a miracle of change, takes place; along the side limbs from junctions to terminals cohorts of vigorous branchlets arise, their new leaves, broad and green, at work in food-supplying, as if the tree were again a sapling. Such new leaves are rarely marked with streaks of yellow, the indication of lack of ability to manufacture plant food.

The large parts of limbs, bare before exposure, become regions of

lively growth by the formation of adventitious buds. Here is elaborated sap in abundant supply in the bast lying between the bark and wood, which is the pathway of distribution of nutritive material or manufactured foodstuff. Not ouly is food here in circulation, that may be made into plant form by growth, but there is always an accumulation of stored food in healthy trunks and limbs and medullary rays, and the utilization, for growth that is beginning here for the first time, is the attractive force that draws it to the point of need. This accounts for the new development which receives the reserve until the new leaves can manufacture for themselves.

Intermingled with the short-stemmed, broad-leaved fruit growth, are a few new sucker-like shoots, especially where the cuts were made; these do not grow lank and long as do suckers in an unpruned tree, where the open spot of light they aim to pierce is small. These and such of the newly-formed fruit branches as would be in excess, especially those higher up, should be taken away, and the open space, once secured, should be maintained as the most important region wherein increased vitality can be gained.

Within the first season, and increasingly so in successive seasons, the new foliage throughout the interior as well as in the center becomes fruitful. The side limbs have impelling influences to growth, not alone at or near their extremities as at first, but all around them, and dead wood, once removed, can never form again.

When these excellent results are gained and the grower reviews the processes by which they were secured, he no longer laments what seemed destructive work in cutting out decadent limbs at the side and the top and is ready to subscribe to the policy of avoiding, in his business as a fruit grower, the distribution of nutrition to regions unproductive of good fruiting branches or fruit. He may, too, doubt the advisability of the plan to permit tree renewal by natural sucker growth, which also has its origin in regions of active sap flow and storage, to the detriment of regular branches.

It may be thought to be well enough to depend on the weight of foliage and fruit of aging trees to open the top enough to receive equal benefits with the artificial treatment described; but such benefits follow only in a minor degree and are temporary, because new growth in the top may be thrifty enough to soon fill such an opening and shut out the reviving agencies. Such dependence is not wise, for the space must be large to bring about the desired renewal.

Growth has its limits, and age will struggle for control; but there is still a third resort, by pruning, to rehabilitate a decadent orange tree and keep it well at work.

As has been said, the reservoir of vital force in that part of the tree above the ground is in the trunk and larger limbs; the weakness appears in their subdivisions, which have small and few yellow or variegated leaves. Since rejuvenation is from within, the poor old limbs may be cut back to points of vital force where new shoots have been made ready, by superior location from the work previously done, to take the place of the old. The tree is then new without as well as within.

When a grower with his best judgment and in due season, in the late summer and again in the winter, has provided sufficient available plant food, has put his soil in mellow tilth after the season's rains or irriga-

tions, and has avoided untimely applications of cold water at the critical period of the setting of the fruit, but has failed to provide in the tree itself extra supplies of growing points in stable locations, in so far he has invited crop failure; for, when the chill nights of spring arrive, and the dreaded June drop period of hot days and drying winds comes on, it is only in the most vigorous regions that the young fruit will have staying qualities. There is no drifting to success in orchard methods, yet seasonal influence will contend for victory, and sometimes reward the thoughtless.

The different processes, all performed in subservience to natural law, have kept alive and in constant use the vital energies, have provided new and better areas for fruit production with a scarcely appreciable delimitation of such area, contrary to the plan of total decapitation at occasional intervals, and, if soil and cultural conditions have been favorable, have left the tree to a green old age. [Applause.]

PRESIDENT JEFFREY. Professor Coit, of the Pathological Laboratory, will now read a paper entitled "Relation of Asexual or Bud-Mutation to Decadence in Citrus Trees." [Applause.]

MR. COIT. *Mr. Chairman and Friends, California Fruit Growers:* I have a short paper which I think will take about ten or twelve minutes to read, and to-morrow, some time, if you wish, I will show the charts which are intended to illustrate this paper. It will take, perhaps, ten minutes more to show the charts. As the subject of my paper appears on the program, it is "Bud Variations," but I would like to change it to "Bud-Mutation."

THE RELATION OF ASEXUAL OR BUD-MUTATION TO THE DECADENCE OF CALIFORNIA CITRUS ORCHARDS.

By Dr. J. ELIOT COIT, Assistant Professor of Pomology, University of California.

It is now coming to be generally recognized that there are, broadly speaking, two kinds of variation in plants: first, true variations or small unstable differences (only slightly transmitted to offspring), which may be due to one or several of three causes; viz., crossing, change of environment, and change of food supply.

When sexual union takes place between the male pollen cell and the female egg cell of the blossom, the nuclei fuse together and in the rearrangement of the nuclear matter in preparation for subsequent division and multiplication of the cells, there is an opportunity for a reshuffling of the cards or a redistribution of the characters which go to make up the new individual. Thus, we find that crossing is a most potent cause of variation, especially when the male and female cells are unlike in many characters. But as our citrus orchards are no longer composed of seedling trees, we are not concerned with variations arising from cross-fertilization.

Another important cause of variation is change in environment. A standard variety of corn will mature in a less number of days when grown in Wisconsin than when grown in Alabama. The Baldwin apple grown near Phœnix is very different from the Baldwin grown near Rochester. Furthermore, change in environment affects all the individuals of a variety. Thus the Washington navel orange from Florida reacts to our California environment by producing more acid, better

shipping qualities, and a better color. All the navel trees brought from Florida may be expected to react in the same way. Should navel trees be sent from California to Florida, however, they would be expected to again display the characteristics associated with the Florida environment. Thus we see that when dealing with clons or varieties propagated by asexual parts such variations can hardly be responsible for the alleged decadence of our citrus varieties.

In like manner, we find that all parts of a clon react in much the same way to a change in food supply, and however important such variations may be when dealing with annual plants, I do not hold them responsible for the wide divergence of types observable in our standard varieties of citrus fruits.

I would, therefore, call your attention to another kind of variation to which De Vries has given the name "Mutation." Mutations differ from variations in being more pronounced in character, in appearing suddenly, and in being at once the starting point of new forms which may transmit their characters to succeeding generations. We have available for study an enormous amount of data shedding light on the causes of variation, but the causes of mutations are still shrouded in obscurity. We may, therefore, leave the causes of mutation to the scientists of the future, and devote ourselves to a consideration of the fact of mutation and its relation to the strange divergence of types in our citrus orchards of to-day.

Every orange tree in its last analysis is found to be composed of cells which are the ultimate units of vegetable life. There are many kinds of cells, but for our purpose we will consider only the vegetative cells of which the entire growing part of the plant is composed, with the exception of the sexual cells located in the blossom. As explained above, the sexual cells contain the machinery for reshuffling the cards of heredity, while the vegetative cells usually divide in a simple manner, giving rise to daughter cells containing the same inheritance as the mother cell. We know that a bud cut from any part of an orange tree will produce a tree with characters like the mother tree, and it therefore follows that every cell in the tree contains, wrapped up in its nucleus, all the characters of the variety. Occasionally, however, it must happen that in some way the dividing vegetative cells allow their hereditary characters to become confused and daughter cells are produced which differ from the mother cell in having a new combination of characters. Whenever such an occurrence takes place in cells composing the apex of a bud, it is easy to see that the resulting shoot would be composed in whole or in part of these new cells, and should the dominant character of this shoot differ from the other shoots on the tree we would at once recognize a sport or bud mutation. Should we take buds from this sporting shoot they will develop into trees showing the new characteristics.

In some varieties this bud mutation is comparatively rare. It has required no great amount of care to propagate the Northern Spy apple true to type for 110 years. The Valencia late orange seems to show comparatively few mutations. I will say, however, that of all the clons to which I have paid close attention, I know of none which even approximate the large number of mutations of the Washington navel orange. We hear complaint on every side of the divergence of type in the Washington navel. If you go out into the average navel orchard to select a

dozen perfect navel oranges true to old standards, you will be surprised at the amount of searching necessary. You will conclude that there has been deterioration in the navel orange due to a divergence of types. It is my belief that by far the greatest part of the divergence is attributable to mutation rather than to variation.

The next point upon which I shall ask you to focus your attention is that *mutations are fortuitous,* that is to say, they occur entirely by chance and can not be foretold. Moreover, they seem to occur without reference either to the economy of the plant or to the desires of man. The desires of man are often antagonistic to the economy of the plant. The chief function of the plant is to reproduce itself. The breeding of walnuts to increase the number of nuts produced is not only highly desired by man, but it is also in harmony with the best efforts of the plant. In the case of oranges, however, the efforts of man to restrict or prevent seed formation is directly contrary to the good of the plant, looked at from the plant's point of view. This has resulted in the case of the navel orange in such an artificial and unnatural plant that it is now entirely dependent upon man for reproduction. Mutation proceeds entirely without reference to any of these things, and we may expect three kinds of sports. We may have those which show new characters of great value. It is to the discovery and propagation of such desirable sports that the hope of our future citrus industry rests. We may also expect a large number of sports which may be classed as neutral. They may show new characters which may be neither objectionable nor valuable. We may, likewise, expect a large number of sports which show new characters which are decidedly retrogressive and objectionable. It is here that we find the answer to the oft repeated question, "Why are my navels degenerating?" Bad mutations have been occurring in our orchards for years and we have failed to prune them out. We have not been alive to the subtle changes which have been taking place.

Retrogressive mutations in orchard trees, however, can not account for all of the enormous increase and wide distribution of poor types. There is another all important factor in this process. You know the man who is ordinarily employed to cut bud wood for propagating purposes; he may be as honest and sincere as any one could wish, but I think you will agree that very few bud cutters have any accurate knowledge of mutation and the principles which underlie it. They are likely to, and in many cases do, innocently cut hundreds of buds from mutating shoots, with final results which can easily be imagined. Too many people think that badly shaped oranges are alone caused by some irregularity in the soil or available plant food, and that trees propagated from such wood will produce ideal fruit when grown on different soil. It is our duty to combat this idea. Soil and plant food may cause variations; barren soil will cause small oranges; a superabundance of organic nitrogen may cause coarse, thick-skinned, puffy fruit; but, so far as we know, these things have absolutely nothing to do with mutations, which occur suddenly and without warning.

In order to keep our orchards true to the best type of navel we should proceed along two lines of effort. First, by very careful pruning. Our pruners must recognize the fact of mutation and be alive to its subtle workings. They must be quick to see and cut out all branches

sporting toward poor types. In the second place, we must be exceedingly careful in cutting bud wood. It may be easy to get wood from the fine, plump, vigorous growths of young trees which have not yet come into bearing, but the practice is a very dangerous one. What if one of these young trees came from a bud innocently cut from a sporting branch? Make it a practice to cut buds from bearing trees when the mature fruit is on and select buds from those branches which produce your ideal of the navel orange. Perhaps you could not put in your time to better advantage than to spend weeks, if need be, cutting your own bud wood, and, if you wish, delivering same to your nurseryman to be grown on contract. You would not dream of sending your hired man-of-all-work into a large herd of cattle to select breeding stock. Then, why should you allow irresponsible men to cut your bud wood?

But while bud mutations may be in part responsible for the alleged decadence of our citrus groves, they may at the same time, as previously suggested, be the hope of our future citrus industry. These mutations are fortuitous; they not only occur along lines of retrogression, but on lines of progression. As pointed out, the qualities most desired in oranges are antagonistic to the objects of the plant's existence, and we may, therefore, expect the number of undesirable mutations to greatly exceed the desirable ones. Citrus breeding by crossing species and the production of such hybrids as the Tangelo and Citrange may be very desirable for some of the Eastern States, and of great scientific interest to Californians, but our industry is based on two or three well tried varieties which will hardly be superseded. We do not regard them as perfect, however, and it is by the discovery and propagation of desirable mutations that we would improve them. Marked mutations along desirable lines are rare, and all honor to the man who has the eye to see them and the presence of mind to preserve them.

We need a Washington navel which will sweeten earlier and one which will remain good later. We need a navel which will hang on the tree like a Valencia, one that is not subject to splitting, one for the Tulare county which will not sunburn, one which will not puff, and one which will stand more frost. We need a Valencia which will not turn green again and which is entirely seedless. We need a Eureka lemon which will not throw out such ungainly long branches and which will produce an even greater amount of summer fruit. It is my belief that mutations of this nature are occurring in our orchards all the time, but searching for them is like "looking for a needle in a haystack." For the man who will find them and propagate them there is awaiting both honor and financial reward.

SUMMARY.

To sum up then the ideas which I would leave with you I will say that I believe:

(1) That a part of the decadence in our orchards is due to divergence by mutation into undesirable types.

(2) That these mutations are not like the variations caused by crossing, food supply, and environment, but are fortuitous and beyond prediction.

(3) That these mutations may be retrogressive, and may in time, if not checked by intelligent pruning and bud selection, cause our orchards to become a heterogeneous jumble of bad types.

(4) That they may occasionally be progressive, and if such instances are discovered and the desirable sports propagated and studied, a wonderful improvement over our best existing types may be in store for the future. [Applause.]

MR. GLASCOCK. We are advised not to cut buds from these shoots; we are advised not to select them from suckers. How can we identify first-class wood?

MR. COIT. If you can find a branch which has ideal fruit on it, select your bud, even if you have to use some angle wood.

PRESIDENT JEFFREY. How is he going to get his nurseryman to do that?

MR. GLASCOCK. I have about 300 Australians that I propose to bud. In order to get good buds I have got to take them off the sucker.

PRESIDENT JEFFREY. Now, Doctor Coit, there is the gist of the meeting. That gentleman is going to do something that will cost him thousands of dollars. It may be absolutely necessary for him to do what he is intending to do; it may be folly for him to do that thing. That is one reason we are here to-day, Doctor Coit, to find out whether he should renovate his trees by budding over, or to have it found out for us.

MR. GLASCOCK. These are what are commonly known as Australian trees.

MR. COIT. If they are, I should bud them over.

PRESIDENT JEFFREY. How are we going to find out whether they are?

MR. COIT. If they are an undesirable type, if they are unsatisfactory, I should bud them over, whether they are the Australian navel or some other undesirable navel.

A MEMBER. Out of what experience do you arrive at this conclusion? Have you observed the rebudding of what we call Australian trees? Have you observed their having been rebudded and then observed for a number of years the character of fruit they produce, whether they did not deteriorate back to that condition?

MR. COIT. I will say that I am a young man and the most of my remarks are based on scientific literature and the publications of the scientific men of the day, but so far as my observations do go I have seen to it that I should say nothing that did not match up with my own observations.

PRESIDENT JEFFREY. You may have an undesirable type of trees right now. Rebud them to typical navels, selected on the doctor's plan. In ten years' time they may have gone right back to the point you are to-day. We don't know about these things and we must know to save you gentlemen money.

MR. STREIGHT. I want to say one word right here. I had five acres of what they called Australian navels. I budded them all over about six years ago and they are bearing as fine navels as are raised in Riverside county.

MR. DEWEY. I would like to answer a question. Mr. Glascock asked the question how to get buds. I want to tell you how to get buds. Never take buds off anything that is upright. Take your buds out of the foliage, never from anything that comes up from the crotches of the tree that was originally a sucker. Look and see if you can find one. You will have to look for them.

MR. JONES. In regard to budding Australian navels; is it necessary or is it advisable to bud an Australian navel to navels, or is it just as well to bud it to Valencias? I have had perhaps 20 or 25 Australian navels all budded over to Valencias. Some of them have been budded only two or three years, but they seem to be very successful and bearing heavily. Isn't it more advisable to bud an Australian navel to Valencias?

MR. DEWEY. In budding over it is immaterial what you bud to.

PRESIDENT JEFFREY. He asked whether it was advisable to bud an Australian tree to Valencias or to go on with the navel type.

MR. DEWEY. Either one.

MR. KOETHEN. As a practical budder, I wish to say this: that after five or six years of budding old trees over and always using sucker buds, I don't know of a single case of Australian navel turning up in those buds, but it was done in just the way the professor tells us to do. I avoided the trees that showed a tendency to mutation, and I believe it is criminal to cut a bud from any tree unless you know its history and know that it has never shown any sign of mutation. The question of suckers has nothing to do with it, is my experience. [Applause.] It is a part of the tree, and it is a sucker because it has not got the light to grow up. Professor Paine showed us that if you had a tree too close the wood will grow up to other light. If you thin out your tree you will have no suckers; you will have bearing wood inside your tree.

MR. SLAUSON. In answer to Mr. Jones' question in regard to budding Valencias or navels, from ten years' experience I would advise the Valencias. The Valencia, as a rule, will make a larger tree than the navel will when it is rebudded, either on a lemon or on an orange.

MR. PAINE. Mr. Chairman, there is a practical question involved there as to whether you will bud the navel or the Valencia. You don't want to bud to Valencias when you find scattered trees here and there. You are, in common sense, bound to bud them to navels.

MR. CALL. I have a question to ask Dr. Coit. I had in my grove that I planted out about fourteen years ago, 5,000 trees that developed into what we call Australians; that is, they are vigorous trees that raise coarse fruit, and I budded them over, selecting the buds with great care from well known bearing trees, marking them myself from thrifty trees, and out of those 5,000 trees 90 per cent are well defined navel varieties. The other ten per cent developed into something I have never had in the orchard before. It was a thick tree, full of branches, little shoots starting out in every direction from every branch, with so thick a top you could not get the sun into it. Those trees we kept pruned for four or five years, and after the first year's pruning we could get a little fruit, but it would be of all sizes and shapes and some with navels and some without. We finally gave that up. I took those trees, about 500 of them, hoping that I might by a stronger type save them, and I budded them over to grape fruit. The first year showed a good growth, the second year a poorer growth, the third year they developed into the same kind of a top, and I finally dug them up. Now, I would like to know what kind of type we had there. I noticed over in Mr. Slauson's grove several hundred such trees. I noticed another grove of similar type running all the way from three to ten per cent running into that thick type of tree. My neighbors have had the same

type and they have concluded, after fifteen years' experience, to dig them up. It does not seem possible to take any kind of a bud and develop afterward.

MR. COIT. It is very difficult to answer that question. I would much prefer to defer my answer until I had an opportunity to study the individual cases. From your description I can not account for it unless, of course, you had bad mutations occurring again and again. If you can have one bad mutation you can have two, of course, and the working over of an orchard into better form means continual oversight and continual watching to keep it true, or you are liable to have objectionable mutations even in those buds. The peculiar case that you mention, not having studied the individual trees, I can hardly account for without looking at them.

MR. BOYD. I would like to ask Mr Call whether he does not think that that depends on the stock?

MR. CALL. Of course, I could not tell that.

MR. BARNHART. If I had an orange grove I would be the last man in the world to rebud it if I wanted to change the variety with a mutative variety. It is a well known fact to all well informed men on plant life that it has a tendency sooner or later to revert to the original, and any man who will depend upon a type of that origin sooner or later will be disappointed.

PRESIDENT JEFFREY. I would like to have read a little resolution of about five lines, passed by the last State Fruit Growers' Convention, regarding the topics we are now discussing.

Mr. Maskew read the following:

WHEREAS, It is quite evident that in future our orchards must be bred up to produce fancy fruit, and to do this we must get rid of the scrub trees; therefore, be it

Resolved, That we each begin keeping a record of the production as to quality and quantity of fruit, behavior of tree, time of blooming and ripening of fruit, on any tree in our orchards that seems exceptionally valuable; and, after two years' proving, of continuous value and fixed qualities, these trees and records he offered to nurserymen for propagation as pedigreed fruit; and be it further

Resolved, That we encourage our nurseries to propagate only the best and most vigorous stock by refusing to buy "seconds" or inferior stock at any price.

MR. FREEMAN. In my experience with lemons more particularly, I have noticed in some years a grove will yield lemons that are quite under the ordinary, as far as grade goes, while the very next year, under no different conditions, it will yield lemons just the opposite in grade. I have noticed that in two groves especially. We have been wondering why that is, and if Professor Coit can tell us, we would be glad to know. Of course, it is a mutation, so far as the lemons are concerned. If we were to treat that fruit as a mutation we would simply cut the whole thing up from the roots. I could show you those conditions to-day, and they are most marked. Another thing I would like to ask is this. Why should a branch from a navel orange tree, yielding the very best kind of navel orange, superior to any other branch on the tree—why should that branch be called a mutation? That is the regular thing, it seems to me, and the other part of the tree is the mutation.

MR. BODENHAMER. This is very interesting to me. I have been twenty-eight years having more or less to do with orange trees and at this time, seventy years old, I am just simply a question mark. Per-

haps I can make a suggestion which seems to involve all these questions, mutations, of the variation of the bud, of the influence of the stock on the bud. Twenty-five years ago I bought at Pasadena navel orange trees budded on sweet stock. There had been no diversion towards wild growth; there had been no deterioration in any particular of those trees. They have borne all these years, fighting for their life, without water, without fertilization. They remain true to-day. I have cut off wagon loads of wood, still the fruit grew, no variation. I have bought stock from various nurseries, many Florida stock, a good many trees budded on the sour stock from Florida. Those trees reverted, many of them, to the Australian tree. Those trees have a habit of making a large tree growth. I have had some of those trees budded over. For a few years we would have a navel orange true to the variety of the tree we took the bud from, but some, in three or four, some in eight years, reverted back to the Australian navel. Of course, this is a question mark. I haven't settled anything. I know less than I did about it twenty-eight years ago, but we contemplate planting hundreds of acres up there. We want to start right in our boyhood days, and we have this idea, that the navel orange tree is a half dwarf, should be grown as a half dwarf, that any attempt to put it on a large stock and make it a big tree would defeat your purpose of fruiting. With this strong sour stock, finally the wild predominates over the bud. I am not giving you information but making inquiries.

The convention here adjourned until 7:30 o'clock p. m.

EVENING SESSION.

PRESIDENT JEFFREY. The convention will please come to order. While the delegates are coming in I would like to employ the time in discussion, in regard to the renovation of citrus trees by pruning. If pruning will restore the trees, will it be a permanent improvement or only for the time being? In other words, will it only last as long as the active root system is a little ahead of the foliage that you leave after you have pruned your trees for restoration? There is an old Gravenstein apple tree in Sonoma county forty-eight years old that this year had fifty-two packed boxes of apples. Every year that tree bears a full crop of apples. Why is it an apple tree will remain fruitful in old age without special care while your orange tree will not? That apple tree was rarely pruned.

A MEMBER. Is that apple tree in an orchard or standing alone?

MR. MASKEW. It is in orchard form. There were not only fifty-two boxes of apples on that tree but there were fifty-two boxes of No. 1, four-tier apples. They won the gold medal.

A MEMBER. What is the character of the soil for drainage?

MR. MASKEW. Excellent. It is more or less on a hillside.

A MEMBER. I don't know that apple tree, but I know some apple trees, and it strikes me that an apple tree does not have such a heavy,

overlapping, smothering foliage as an orange tree does, and there are natural vitalities, too.

PRESIDENT JEFFREY. Somebody told me to-night there were 12,000 acres in one county in southern California where, if the trees continue in the same condition they have for the past two or three years, those trees will not be profitable to the grower. If that is the case, we are justified in coming here.

MR. FULLER. I think it is fair to this convention that your informant should state something of the condition of those 12,000 acres.

PRESIDENT JEFFREY. As he told me this confidentially, I won't even name the county, but it is not a hundred thousand miles from Colton.

MR. FULLER. I can see, if there is a rise of the water table in such an area, that that might be sufficient cause why any tree should go out of bearing, whether it is an orange tree or apple tree.

PRESIDENT JEFFREY. Then shouldn't we have that investigated and know why they don't get some good out of those 12,000 acres? Isn't it just as much an advantage to have drainage investigated as any other proposition relating to decadence?

MR. KOETHEN. I don't think it is necessary to find out just where that 12,000 acres is. I know that last year—not this year just finished, but the year before—there were something like a million orange trees in California and a million and a half boxes of fruit, which only gives a box and a half to the tree, which is not enough to pay.

PRESIDENT JEFFREY. The citrus trees of Butte county—that is so far away that there can't anybody jump on to us—just raised three quarters of a box to the tree last year; that is about the average, and yet they have some very profitable orchards there; some produce three or four boxes, but the average makes just three quarters of a box. In the southern part of the State there are many orchards that do not produce that.

A MEMBER. What is the average age of those trees?

PRESIDENT JEFFREY. Fifteen years, say.

MR. BOYD. I am local statistician for the department in Washington in regard to fruits and farm produce, and a year or two ago they sent to me to furnish the total product of Riverside and also how much per acre, and I got my statistics from the county assessor of the bearing trees and the number of boxes. Any one can easily get it. What I made out from the actual figures and the actual facts was that the orchards of Riverside produced 100 boxes to the acre, and I don't think they produce as much to-day.

PRESIDENT JEFFREY. That is one box to the tree?

MR. BOYD. Yes.

MR. DREHER. I think Mr. Chase testified in the rate case that the crop was 105 boxes to the acre, taking the official number of boxes shipped by the railroad. It makes no difference whether it is 12,000 acres or 1,200, the fact is that the orchards are not producing as they ought to be, and the question is, do we want to know the cause?

PRESIDENT JEFFREY. Do you think we are justified in holding such a meeting as this to consider these questions?

MR. DREHER. I think so, and always thought so. There isn't a man within the reach of my voice but what thinks there is something radically wrong.

MR. BOYD. I would like to give you some other facts that would justify the calling of this meeting. I would say that I am one of the oldest growers in southern California and my orange grove is not paying expenses. I have a neighbor who took an orange grove that was run down and they put some work and some fertilizer into the orchard and they brought that up. There are two orchards adjoining me that have been abandoned because they don't pay. To be sure, one has been put into town lots. There are other places where you can't see an orange on the tree. I don't see why we get such reports as to 50,000 car loads of oranges. I don't care what they say about it, but that is the condition in my part of the country, and it is one of the oldest orange growing localities in the State. Some are under the new irrigating system. My own is under the old Riverside system. I believe my orchard can be brought up to a paying condition. If I did not have an income from other sources I would be obliged to go out of business, and there are a great many other people in the same condition. They send people up to the assessor who own good groves and they tell them what they make from their groves. They don't send me up, who don't get enough out of my grove to pay for the water. They send those rich men up to Sacramento and they tell the assessor what they make. If they send me and my neighbors we can tell what we make on our oranges, and that might have a little bearing on the railroads.

DR. OSMUN. I would like to ask the last speaker what the maximum amount of his crop was in the years gone by. I would like to see what the decrease has been and in how many years.

MR. BOYD. Originally I had thirty acres in oranges and the last year I had it I couldn't keep it because I had a mortgage. You know what that means. I got $6,000 off of my orchard the last time I had a crop. Since that time it has been going down and down. I only own five acres now and last year I got $200 off of it. You know you can't run an orchard without a hundred dollars an acre. No man will say that you can keep it up for less than a hundred dollars an acre.

PRESIDENT JEFFREY. Professor Rolfe of Florida says that too much pruning of oranges makes die-back. We have die-back in the Mills orchard right back of Pomona. There is a row or two of those trees that are dying in the tops. It is also up in the foothills of Pomona. Nobody knows what is the cause of it. Ought not we to pay some man five or ten thousand dollars, if necessary, to find out these things? Can the botanist help us any, Mr. Barnhart? Is botanical science of any value to us? Should we have a botanist in the commission that is going to investigate conditions here?

MR. BARNHART. *Ladies and Gentlemen:* I have been growing trees and plants all my life. I have learned some things in that time that it does seem to me will apply to the citrus fruit proposition that is being discussed here at this time. The first thing I wish to say on this subject is that there are fundamental principles that govern the growth and development of plant life that you dare not violate without paying the penalty. Now, let me begin. We heard to-day about stocks, about grafts, about disease, and all that sort of thing, playing an important part in the profit or loss of citrus fruit growing. If you will take time to study the situation you will discover that a seedling tree to begin with has two thirds of the tree underneath the ground and one third of

the plant is above ground. You take up that little tree and the first thing you do is to mutilate and interrupt the natural functions of the tree by cutting off the tap root. You begin to violate the first principles in the law of nature governing plant life. You put it next in a nursery row. You grow it carefully and the custom is to have a one-year-old top on a two-year-old root or a two-year-old top on a three-year-old root. In transplanting the little tree into the nursery the first process of mutilation is begun, and then, in order to recover and get back to its natural principles again, those roots go down, down, down and spread out, out, out. Then the orchardist wants his trees. The nurseryman goes at it with a sharp spade and he begins to ball it. He takes 90 per cent of the roots of that tree away and starts it out on its mission in life with that second mutilation of a more terrible character than he began with in the baby plant. This may be overcome. The tree will recover, if given an opportunity, from even that terrible ordeal. Then comes the desire to make the most out of the land. You will plant 100 to 110 trees to the acre, and then the struggle of life and death begins with the mutilated tree. It is true that the tree will not occupy the ground for several years, say four or five, and this feeding process goes on all over and the ground is permeated, filled with roots to maintain that tree. Then disease sets in in some form or another, and why? First, because of the mutilation begun with in the baby plant; second, in the mutilation in transplanting it in the orchard; and, third, its starvation. We should plant 50 trees to the acre. The greatest citrus fruit tree grower, I believe, in the world, confessed to me three years ago that 50 trees was all that an acre of ground should be planted to in order to be a successful, profitable citrus orchard when it was fifteen years old.

I am not a citrus fruit grower only in an experimental way. My business calls me over different parts of the State and I don't hesitate to inquire into the reason why this is so and that is so, and my observation leads me to believe this. As remarked in the address by the President, there are soils that are wholly unfit for citrus fruit culture. Then there are soils and orchards to-day that have become wholly unfit by the method of cultivation. When I first came to this State fifteen years ago I saw an orange grove of about 1,000 trees, maybe 1,500, that bore bountifully of the finest kind of crops. The soil was about 50 per cent little boulders about as big as my fist. They irrigated faithfully and in five years' time the orchard became so unproductive that they decided to abandon it and make firewood of the trees. A change of superintendents took place. The orchard belonged to a company of people who loved to experiment and had plenty of money to do the experimenting with. They gave the new superintendent free rein and the first thing he did was to buy the strongest plow that he could buy. He turned a 12-inch furrow about 15 inches deep with eight horses. He next secured a subsoil plow, the strongest that he could have and put ten horses on that and tore up the whole orange grove 3 feet deep. And will you believe me! That man hauled fertilizer from a packing house and stable manure 35 miles and put on that orchard—

PRESIDENT JEFFREY. Time is up, Mr. Barnhart. Anybody who can tell a bigger story than the chairman has got to be called down. I asked you a question and you have not answered it. Can the botanist be of any service in determining the causes of decadence in our citrus orchards?

MR. BARNHART. No, he can not.

PRESIDENT JEFFREY. Well, he can. Mr. Barnhart has helped us a great deal to-night, and he is a botanist.

A MEMBER. I move that the gentleman's time be extended long enough to tell us whether that orchard died or not.

PRESIDENT JEFFREY. Mr. Barnhart, you told us some very splendid facts and I thank you for it. You did not tell us whether they were planting that orchard for the benefit of China or the United States. The gentleman wanted to know if the orchard died.

MR. BARNHART. No. I want to tell you that I went up and saw that orchard. They had developed to a size of 15 inches in diameter and two years ago the frost killed those lemon trees to the ground and I had the pleasure of grafting them to navels this year, but the oranges were perfection themselves. Gentlemen, it was a pleasure to me to look on that rejuvenated orchard, with the most beautiful fruit, no scale, no soot, no dust, no dirt, 35 miles from the railroad.

PRESIDENT JEFFREY. Now, gentlemen, I would like for somebody that has been here for more than twenty years to give us five minutes' comparison, as to the trees from which buds are cut now compared with the trees from which they were cut twenty years ago. That is, twenty years ago all the orange trees from which buds were cut were typical navel trees. When you go out to cut buds, or your nurseryman goes out, does he cut from those same typical trees or have the trees gone into decadence so he can not get the buds?

MR. BOYD. One of the oldest orchards in Riverside, in fact, the original orchard, was budded with the buds that came from Washington. Ten acres of it brought in $10,000 a year. Recently, I believe, it has fallen into decadence somewhat. Mr. Cundiff can tell you more than I can.

MR. GRIFFITH. I have a tree that is probably four or five years old. It is budded from the trees in Washington, so it bears the relation of sister to the typical tree and I don't think Mr. Boyd could tell the difference between that tree and any other tree if he was in the orchard.

PRESIDENT JEFFREY. The question I was trying to get at was to get one on the nurserymen. Do they pay sufficient attention to the stock from which they take the buds? Here is a sister question: Do citrus nurserymen usually pay any attention whatever to the fall development of the tree from which buds are to be taken next year?

VOICES. No.

PRESIDENT JEFFREY. Do they have any pedigreed citrus nursery stock for sale in southern California?

MR. PAINE. There is one simple answer to about all those questions. We are an unscientific set of orchardists.

PRESIDENT JEFFREY. We have a movement on foot in the north to have a record kept of a number of deciduous trees there for five years.

MR. HAMBURG. I would like to say that I have a pedigreed tree and I have a pedigreed orchard, six acres, that came from Mr. Thompson's, and all the orchard of six acres is identically alike.

PRESIDENT JEFFREY. I was going to tell you of a nurseryman in the north who bought all the buds from a row of orchard trees. He is now advertising pedigreed stock. There were half a dozen trees in that orchard row that bore four or five times the fruit that the average

tree bore and they were marked by the owner. The nurseryman sent his foreman down there and he did not touch the typical trees because he found better buds on the trees which never bore. Now, that is the way too much of our pedigreed stock is obtained.

MR. HAMBURG. I selected those buds myself; I did not send any hired man.

PRESIDENT JEFFREY. That was for your own orchard?

MR. HAMBURG. Yes, and trees that I have to sell.

MR. PAINE. There is a question I would like to propound, which I can answer and others follow, if they will, concerning a decadence that occurs in the orchard from soil mismanagement. Everybody knows it as soon as I mention it. We irrigate and plow and cultivate in the spring time, but during the rest of the year along the rows where the water goes, you will find irrigated ground which once had good roots in it which have become neglected and have become sick and died. It stands to reason that if that has had no regular draining all through the hot summer months, no regular food supply, that condition would affect the trees. I know I can go in there with a pick and I can't get the water there without a great deal of labor.

PRESIDENT JEFFREY. Now, we will change the program and have a paper read by the Secretary, "The Physiological Effect of Windbreaks," sent down by G. W. Homans, State Forester. Mr. Homans is fighting fire to-night away back in the woods near Blue Canyon in Placer county, and has been for a week, and he is not able to be here. He has had this paper prepared for us in his office by Allen H. Hodgson, Assistant Forester, and he sends his regrets that he was not able to prepare the paper himself.

Mr. Maskew read the paper referred to, as follows:

THE PHYSIOLOGICAL EFFECT OF WINDBREAKS.

By ALLEN H. HODGSON, Assistant State Forester.

We of the State of California have been liberally dealt with by nature. Our resources are wonderful when compared with those of other states and countries. Our climatic conditions are so varied that we can produce nearly everything, from products demanding the most tropical conditions to those demanding severe frosts for best development. We depend upon our forest products, our mines, our stock ranges, and our agricultural outputs, as well as our climate, for vast incomes, which make our State one of the richest in the Union, and because of the diversified character of these resources we are made one of the most independent of states.

Nature has indeed been kind to us, so friendly, in fact, that we have almost reached the point of believing that our conditions can not be bettered by artificial means. This fact, however, should not be lost sight of because nature can assist in our development only by giving us conditions which make it possible for us to do for ourselves. Through artificial means, nature's gifts can, in many cases, be greatly improved upon.

Our State has so far flourished and advanced by depending chiefly on its natural resources which had, previous to our coming, been stored up for centuries unused. Because of our increasing population and the

greater demand upon our resources, we have now reached that stage in development where our condition must be bettered by artificial methods, which will assist our already prolific lands in producing a maximum yield. Our irrigation systems must be developed, our lands fertilized, and better species of trees, vegetables, and plants cultivated.

Along this same trend we have to consider the advisability of establishing "windbreaks" or "shelter belts" for the purpose of protecting our orchards and crops from undesirable climatic conditions. It is an established fact through casual observation and through organized experiments that windbreaks assist agriculturists and fruit growers in two well defined ways: First, by preventing the free sweep of strong winds from breaking the trees and creating severe atmospheric changes; and, secondly, by conserving and balancing atmospheric moisture.

In the State of California, especially within the Sacramento and San Joaquin valleys, both of these features are of prime importance, and should be given full consideration because of our severe north winds, which dry out and blight our crops and damage our orchards. These winds affect our agricultural pursuits in a number of ways—they cause great damage by breaking the limbs of orchard trees, by shattering blossoms, and causing imperfect pollinization. They dry out the buds and the growing young shoots, and in many cases cause the whole trees to die. It is not uncommon to see branches scalded by the heat and drying effect of these winds, and in many cases fruit is damaged on the windward side in such a manner as to spoil it for market.

In many cases crops of nuts, such as almonds, have been ruined, and we all know the effect of the winds upon the grain crops of the State—drying up and shrinking the kernels of grain while it is still in the milk, as well as shattering the grain after it has ripened and before it is harvested, thus in many cases decreasing the yield by a very large per cent.

In many parts of the State our orchards and crops are blighted by frosts, and large amounts of money are expended on smudge systems for protection against the cold snaps. Fruit buds can endure 2 or 3 degrees severer freezing when the air is moist, and so if we can devise methods of overcoming the evaporation caused by these winds we can greatly assist in solving the frost problem.

In experimental work on sandy lands in Wisconsin, Professor King found that, with a gentle breeze blowing, evaporation a foot above the ground was 25 per cent greater 20 rods out from the west edge of a field than it was 3 rods out. In this case there was a windbreak 12 to 15 feet high on the west side of the field. Even with only a hedge of scattered bur oaks 6 to 8 feet high, evaporation was 30 per cent greater 300 feet to leeward of the hedge than at 20 feet.

Not only does the land dry out much more rapidly with a strong wind blowing over it, but the finer portions of the soil itself may be blown away, greatly decreasing the soil fertility and lessening the power of the soil to hold moisture, for the finer the soil the greater its moisture-holding capacity. Also in many cases, winds carry sand particles which cut off young plants or cover them over. Another point in this connection is that under ordinary conditions of farming the finer particles of soil are brought to the surface every time the land is plowed or worked. The wind carries many of these away, so that the natural tendency of these soils, if allowed to drift, is to become coarser, less able

to retain moisture, and more subject to drouth. Besides, in these coarser soils, any vegetable matter that may be added in the form of green or stable manure is much more quickly burned out and the humus reduced to ashes than on the finer and more compact soil of the original field. This we do not want. For often a big yield depends upon there being a large quantity of humus.

It has been observed that crops in the Sacramento Valley on the leeward side of natural windbreaks have been preserved and saved from the damages of winds while other crops in the same vicinity which were not protected were ruined and lost.

The farmer of the Middle West has learned by experience the benefits of the windbreak, and orchardists have long known its value; but that crops in fields protected by timber-belts yield better than in unprotected fields, and especially that winter frosts are prevented by such protection, is not fully realized by farmers. By preventing deep freezing of the soil the winter cold is not so much prolonged, and the frequent fogs and mists that hover near forest growths prevent many frosts. That stock will thrive better where it can find protection from the cold blasts of winter and the heat of the sun in summer, is another fact which gives value.

To sum up, windbreaks can exert a great influence upon an agricultural community by protection from cold, lessening of evaporation, decrease in windfalls and breakage, assisting in pollinization by checking the force of the winds, preventing the blowing away of the finer particles of soil, and by harboring atmospheric moisture.

In my belief the whole climatic condition of a region can be made more moderate and regular by the use of windbreaks, and in the two greater valleys of California, where the north winds are so severe, that a complete change can be brought about by the systematic use of windbreaks. The time will come when these two great valleys will be divided into small farms, and each small farm and orchard will be protected by rows of tall trees running east and west, and when that time arrives the problem of the characteristic California north wind will be solved, the frosts will not be so severe, and the moisture and soil conditions will be bettered. [Applause.]

PRESIDENT JEFFREY. I am going to ask a question for Mr. Griffith to answer. Will the well-known advantages of windbreaks offset the liability of frosts that the windbreaks bring to the orchards in the narrow valleys?

MR. GRIFFITH. There is no frost on my ranch. I have had no personal experience to answer that question; but my observation in my valley where there were some time windbreaks planted, and now taken away, is that windbreaks are not of any benefit. In fact, I do know a place where the oranges were said to have been frosted right under a windbreak.

PRESIDENT JEFFREY. Mr. Leroy, are they taking the windbreaks out in this section of the country or planting more?

MR. LEROY. They are taking them out in some cases, but we have very seldom had any windbreaks in this immediate section. We have comparatively few winds. In the Cucamonga section they think they are a good thing. Pretty nearly every ten acres up there is surrounded by windbreaks. I think, as far as frost is concerned, that for a few rows

where the shade trees affect the orange trees they are a benefit, but in many cases they back up the cold if they are on the south side, and in that way a number of the trees are damaged. I think there are some people in the hall who have had experience in that direction. I know the Richards ranch—they have probably the largest windbreaks we have around this neighborhood; I don't think they were put there for windbreaks, either—but the people living north of there complain a great deal about the Richards ranch trees backing up the cold and frosting their oranges.

MR. COIT. May I be permitted to say a word, Mr. Chairman? It seems to me that this windbreak problem turns on the point as to whether we want a windbreak. The windbreaks usually have the effect of backing up the frost. If we plant trees thinner and leave them a little more open, we will at the same time allow enough circulation of air to pass through to prevent a frost pocket being formed.

PRESIDENT JEFFREY. After they all get to using these heaters like we saw up here, would not a bordering row of trees around your orchard make it easier to protect the orchard by heating than if the windbreak was not there? Will that offset the frost disadvantages, Professor?

MR. COIT. It seems to me it would, but some of these things would have to be tried.

MR. LAIDLAW. It seems to me it is a waste of time to talk about raising windbreaks in this valley. The big northers of winter seldom reach us. When they do it is only an average of one in four or five years. A windbreak renders about four rows of trees, probably, useless and it will only protect at the best about fifteen rows; so the experience of the orange grower in this valley is that it does not work.

PRESIDENT JEFFREY. The interest of the windbreaks to this convention lies in this. By the discrediting of windbreaks can we help to prevent the decadent conditions of our orchards? You have seen trees burned on the north side by the wind, and it has made some physiological derangement of that tree by burning the north side of the tender shoots. What interests us to-night is not to settle the broad problem of windbreaks, but see if we can use some one in determining their ultimate effects. When your committee goes before the University of California or the Pomona College with the proposition to give us a dozen men for three or five years, they must know what to tell them. When your committee comes before the committee of the senate and house of representatives you will want to get them interested in it. That is the reason I asked you if a botanist could help. Who will answer some more of these problems?

MR. BODENHAMER. I don't think this question of windbreaks can be settled in a general proposition. For twenty-eight years, in the first place, in Pomona and east of here, when this plain was all a desert, the wind conditions were very different from what they are now. There at Upland and Ontario we had the Santa Ana wind that blew through the Cajon Pass. When they attained greater force they would spread out through Chino. That was the only harmful wind we had until 1888, then we had a wind that came directly from the mountains. It blew down all the boom hotels in southern California. Discussing those things at that time, the inference was that when this valley was

covered with trees and vegetation the surface of the earth was kept cooler and these winds would not rush in to fill the vacuum. For many years at Ontario and Upland we have had no harmful wind. Many windbreaks were planted, but they are all being taken out now. We have had ample opportunity to observe the frost conditions produced by these windbreaks. A great many cypress hedges were built. I have seen a lemon tree near one of those windbreaks killed. Last winter, the coldest winter we had, on Eighth street there were some windbreaks opposite Mr. Dawson's and Mr. Black's. North of those windbreaks was frost; some of the trees were frosted, half the top frosted away. Just east of these windbreaks there was another lemon grove, a mature grove, in fresh, vigorous condition, and you could not see any frost on them. A young lemon grove was diagonally across the street from the end of this windbreak, and except a few trees that were up near the end, there was no frost on the young lemon trees. We have had an opportunity to observe that the windbreaks do still the air and create that frost condition, and they have all been taken out.

MR. BARNHART. The orange grove that I referred to was completely surrounded with a most luxuriant growth of olive trees, 50 feet high, and two years ago they lost every orange in that orchard. In addition to that olive windbreak they burned twenty-five tons of hay and fifteen cords of oak wood on one night to save that crop of oranges.

PRESIDENT JEFFREY. Mr. O'Gara should have been here tonight. He has been employed by the Rogue River Fruit Growers' Association to study these questions. They give him $5,000 a year, and he is employed there now; he got so busy that he could not come, but he is driving the frost back with cordwood. You can not do that in southern California, but there is plenty of wood there and Mr. O'Gara has been very successful in driving the frost line farther up the hills, just as you burn your coal baskets and your oil buckets. Now we should nominate our committees.

The following named gentlemen were nominated as members of the Committee on Resolutions, and the secretary was instructed to cast the ballot of the convention for them; Nathan W. Blanchard, of Santa Paula; A. F. Call, of Corona; Fred J. Smith, of Pomona; Mr. Stone, of Pasadena; Dr. Osmun, of Whittier; Dr. Hardeman, of Tulare county; B. B. Wright, of Riverside, and Roy K. Bishop, of Orange county.

On motion of Mr. Dreher, duly seconded, it was directed that all resolutions offered be presented to the Committee on Resolutions.

PRESIDENT JEFFREY. We will now hear a paper by Mr. Maskew—"Investigation, Demonstration, Practical Application."

MR. MASKEW. *Ladies and Gentlemen:* The following remarks are simply expressions of individual opinion upon the subject in general.

THE RELATIONSHIP BETWEEN SCIENTIFIC INVESTIGATION, DEMONSTRATION AND APPLICATION.

By FREDERICK MASKEW, Assistant Superintendent, State Insectary.

The scientific investigation of agricultural and horticultural problems is invariably brought about by popular and insistent demand on the part of those producers who find their net profits being annually reduced by causes apparently beyond their individual control. Their attention to the necessity for a thorough, complete, and final determination of the causative agency of the difficulty with which they are contending, has been concentrated by the several theories advanced as a result of cursory—or perhaps a better expression would be—outside examinations of the problem involved. This is often further intensified by the great variance in diagnosis and suggested methods of control, which tend to aggravate rather than relieve the situation. These first aids to the wounded have served their purpose in that they have shown to those interested the urgent need of promptly obtaining the skilled services of a specialist. Nor is it considered sufficient that the specialist shall be ultimately able to prove the true source by tracing the difficulty to its origin, and showing in sequence each delicate relation between cause and effect. He is, in addition, expected to devise and bequeath a practical method of permanent control.

If the general anticipations and fervent hopes of success entertained at the outset of the investigation are to be realized in their fullest measure, unlimited time must be freely given to the investigator. No one thing detracts from complete and perfect success more than expressions of impatience regarding the progress of the work. Positive proof must come to the investigator first. He alone should be the judge of when the study of any or all factors in the case have reached a point justifying conclusions. Hearty coöperation and encouragement on the part of every one in the community, no matter whether his property is afflicted or not, should be freely extended to the work. This phase of the problem is, however, assured in advance, for the generosity of California fruit growers in placing their property at the service of research workers is already a matter of horticultural history.

Still another factor in research work, one that has perhaps proven itself worthy of continuance—especially so where mechanical means of relief are sought—is the association throughout the entire investigation of an eminently practical man with the scientist. Such an associate should be one well versed in all the orchard and field practices and customs peculiar to the locality. While the purely scientific joy that follows the solution of the problem in hand may satisfy one, the economics of continued, practical application on a commercial scale of the results obtained are what interests the other. Experimental work is invariably subject to great modifications of cost and methods. The perfection and introduction of these at an early stage conduces to the prompt adoption in general of the means of control offered. This constitutes the real value to the community of the investigation. The work-a-day world is prone to look upon the scientist as a Dreamer, but when you succeed in getting a Dreamer and a Doer working together in perfect sympathy upon any problem the results desired are sure to come thick and fast.

During the scientific investigation of most horticultural problems certain phases of the work may have reached a definite and satisfactory solution long before the investigator is ready to sum up the report of his labors. These findings may be offered to the community interested as a report of progress, in the form of a demonstration given under the supervision of the investigator in person. Such a demonstration is of incalculable value for many reasons. It maintains and augments popular interest in the work; it furnishes an ocular proof of the correctness of the findings, and is more convincing and permanent than any amount of facts set forth in cold type; its success may enable the growers to commence controlling some of the sources of loss at once. The investigator being present is able to correct any miscarriage of his instructions that might occur in manipulation, for later on he may not be available for this purpose, due to the possibility of his promotion or transference to other spheres of activity, or even if this is not the case, he invariably leaves the field of action on the completion of his work, and usually a long period elapses before the report of the work is printed or becomes available. And, further, the scientific investigator in recording the final history of the research work in which he has been engaged usually selects his diction in consonance with the dignity of the undertaking and the respect due to his brother scientists throughout the world. This is as it should be. Unfortunately this is often above the heads of the men upon whom we are eventually compelled to depend for the performance of the actual work outlined.

The general plans the campaign, but each individual battle is won by the ability of the privates to hit the mark aimed at. So in the final analysis, the commercial success of the results of these scientific investigations hinges entirely upon the ability of the workmen to understand and apply in all its details the prescribed formula.

This is where the value of the practical man will first be apparent. His acute perception of the principles of application in general are what raised him from the ranks in the first place. Having prepared himself for the occasion, the demonstration will be his opportunity and your gain. Equipped by long experience, with a full knowledge of how to do things, he now has the added knowledge of why they are done. The gradual development of the work in hand has been a revelation to him. The orderly sequence in which each factor in the problem has been tried out has enabled him to absorb and assimilate the principles involved, so that at the demonstration he is able to act as interpreter as it were and by his knowledge of economic ways and means, and also by his ability to deal with both the subject and the workmen in easy, familiar, colloquial terms, successfully translate pure science into a commercial commodity.

Once it has been proven that the true source of the difficulty has been discovered and an adequate means of control prescribed, either by demonstration or by published report, the application of one and relief from the other then resolves itself into the results of our own actions. Complete consummation of long-cherished desires should not be allowed to perish through inaction. This is no time for indifference, apathy, or half measures. On the contrary, the fact that a full measure of what was asked for has been received, calls for prompt action, unity of purpose, consolidation of effort and combination of community interests,

in applying the accepted means toward a desired end. The awakened attention of the public, in general, always incites the activities of the charlatans, empirics, and quacks, whose prime interest in the matter is chiefly the disposal of their wares and the accretion of their own wealth, and to the end that the false may be eliminated and the true method promoted, calls for both example and precept on the part of all those who really desire larger crops of better fruit for less cost of production. [Applause.]

PRESIDENT JEFFREY. Mr. Maskew's paper is really a plea for action of the fruit growers in trying to get investigation, scientific research, which will unfold and uncover some of the mysteries which seem to be surrounding the citrus business to-day.

A MEMBER. I would like to have you give us some idea as to where these several letters came from that indicated such a decadence of orange prosperity. We don't find it in this convention.

PRESIDENT JEFFREY. We brought down perhaps 75 letters, every one of which approves of the necessity of an investigation of some of these points. Most of them state that the conditions of the orchards are such as to justify it—not every orchard, but the orchards of large areas. Those letters will be on the secretary's desk to-morrow, perhaps 75 of them, selected out of a correspondence of about 150 letters, selected because they all approve of this meeting and most of them stating that it is necessary to have this investigation.

MR. DREHER. I would like to know whether you want more proof than the fact that was stated before, that the orange groves of Riverside produced only 105 boxes to the acre. Some of those groves produce 10 boxes to the tree over there.

MR. SMITH. In furtherance of what Mr. Dreher says, my recollection of the testimony presented before the Interstate Commerce Commission was to the effect that throughout the whole State the average was 115 boxes to the acre. Taking the assessor's figures, and the railroad figures, it amounted to 115 boxes to the acre for the whole State, orchards in bearing only.

DR. OSMUN. If that be true, that an acre, planted 108 trees to the acre, produces 115 boxes, then this convention has been called in good time, because I know lots of orchards that give six or seven packed boxes to the tree, and if the average is only a little over a box to the tree there must be some underlying cause that brings this thing about. It must be either lack of fertilization or overfertilization. A gentleman just made the remark that off his 30 acres his first crop was $6,000 and it degenerated to less than $100 an acre. What was the reason? Was it because he did not fertilize enough or overfertilized; that he did not irrigate enough or overirrigated; that he did not cultivate enough or overcultivated; or all the other questions of cultural methods that we are familiar with and that we use day after day? I think if what Mr. Smith has stated here that was stated before the Interstate Commerce Commission is true, then your question is answered by what Mr. Smith says, that there is a decadence in the orange groves of southern California, and it is high time that we knew what caused it.

MR. DREHER. Mr. Chairman, if you want further proof, take into consideration that there are 125,000 acres of citrus groves in this State and you only ship 30,000 cars of fruit—one car to each four acres.

PRESIDENT JEFFREY. Mr. Schultz's report shows that in Tulare county last year there have been planted square miles of trees; there have been expansions made in Riverside and all over the valleys between here and Los Angeles, until there are tens and hundreds of thousands of trees now bearing, and in the extraordinary year coming the railroads predict only 50,000 car loads. There has been but one year in the history of the industry when you have reached 40,000 cars. If some orchards are going into decadence that have been cared for with all the zeal and intelligence that can be applied by the owner, it is going to be a cumulative proportion and other orchards are going to fall by the wayside, and it is doubtful if we make any increase. If the demand of North America increases, we must keep up with that demand and try and help men who have got their all invested. I think, with Mr. Dreher, that this meeting is justified.

MR. LEROY. I think also that it is high time some such question as this was put before the people. Ever since I have been in California the method has been to have all of our papers publish about some big grove that has produced $10,000 to 10 acres, and we hear nothing whatever about the average grove or the people who are not paying interest on the money invested. There is one grove here that I believe those figures as given to the Interstate Commerce Commission are the correct ones. We have a grove in this section that produced last year 20 boxes on the average to the tree. That will be heralded all over this section, but the hundred other groves that produced not enough to pay the interest on the money are never heard of. It is time we took a little bit of the real estate boomer's literature out of the question and gave a little bit on the other side.

MR. MOORE. In connection with this subject I think it would be very interesting to know something about the cost of raising a box of oranges. I heard a short discussion between two orange growers this noon and one of them said that on his little 11-acre piece his expenses were $2 a tree. The other one, who has a hundred acres, about, looked at him in surprise and said, "You are the first grower that I have met that has been honest enough to come out and say what the place actually cost him. My expenses have been exactly $2 a tree for some time." Now, if we are paying out $2 per tree expenses and getting back a box of packed fruit, what are we up against?

MR. BARNHART. If this convention serves no other purpose it is worth while, because I discover that it is going to clear the atmosphere of misrepresentation that has gone out from this United States of America about the wonderfully fabulous returns on citrus fruit. I do know of one grower who four years ago gained $700 an acre profit on his oranges; the second year the same; the third year I think his net profits to the acre were $350, and this year, gentlemen, I don't think he will get a hundred. That gentleman, of course, did not hesitate to tell his friends about the fabulous profits that he secured from his little grove, and the result has been that a lot of individuals with more enthusiasm than wisdom, and more zeal than knowledge, have rushed into citrus fruit growing in that section of the country, and I am afraid sure disaster will be the result.

PRESIDENT JEFFREY. The deciduous growers are up against the same thing, and at the last convention, which was held at Watson-

ville, they passed a resolution advising growers to stop planting Tokay grapes, but to plant Bartlett pears and plums and almonds. The real estate men jumped all over the people who attended that convention for making that kind of an honest, plain statement. That resolution was made by a body of fruit growers, and they did not care for the real estate men. They advised everybody to quit planting Tokay grapes especially, because there was such a flood of poor Tokay grapes offered to the market that for two years there had been no average profit in the business. If they have got the courage to say those things up there, it seems to me folly to do anything else but tell the plain facts down here. It will help you, because every man that goes into the orange business is a competitor. As a marketing proposition it is not wise to encourage competitors unnecessarily or by telling high-colored stories that induce them to go in. I think we will come to the conclusion that it is time to stop playing to the real estate men and play to the men who fix your tariff and the freight rates and the Interstate Commerce Commission. It will make your land values more stable and secure.

MR. BODENHAMER. I am a better farmer than I am a parliamentarian; I am out of order, but this leaves me hungry for information. We do know there are many groves that pay from three to six and eight hundred dollars an acre. We do know there are many groves that pay nothing and never can—thousands of acres. How are you going to make a practical investigation of these conditions. The chairman has cited a grove of ten acres that is dying back. Can we have as an outgrowth of this convention an agency to make a scientific investigation to ascertain whether there is alkali there?

PRESIDENT JEFFREY. We are going to try to solve that tomorrow.

MR. FULLER. I am a little confused about that total acreage of oranges. It is stated here that it is 125,000 acres. What does that mean? Is it bearing orchards or the total setting of young trees and old trees?

PRESIDENT JEFFREY. Bearing orchards.

MR. FULLER. What do you mean; four years old and older?

PRESIDENT JEFFREY. Yes, sir.

MR. FULLER. We know that a four-year-old tree does not bear very much. It isn't fair to call a four-year-old tree a bearing tree.

PRESIDENT JEFFREY. The law calls the tree a bearing tree at four years.

MR. FULLER. But you and I know that that is not a bearing tree. We might as well try to state the facts correctly.

PRESIDENT JEFFREY. What are the facts?

MR. FULLER. I should not call a four-year-old tree a bearing tree, so therefore, I should not say there were 125,000 acres of bearing trees in California. If it is 100,000 trees and we should have 50,000 car loads of oranges that makes half a car load to an acre, and as we get about 400 boxes in a car it makes 200 boxes to the acre, which is considerably different from the proposition of a half a box a tree. Statisticians are good. Sometimes they are hopeful, like the real estate statisticians. Sometimes they are melancholy. But we might just as well get statistics that bear out a truthful proposition as far as the bearing of California orchards per acre.

MR. WRIGHT. I have been growing oranges for a good many years in southern California and I know orchards which have borne well and which are not now bearing well at all.

PRESIDENT JEFFREY. Do you know many such orchards?

MR. WRIGHT. I do. I do not know a single navel orchard in southern California, twenty-five years old, which is bearing anything like so much fruit as it did ten years ago.

The convention here adjourned until Wednesday, September 14, 1910, at 10 o'clock A. M.

SECOND DAY.

WEDNESDAY, September 14, 1910.

PRESIDENT JEFFREY. The convention will please come to order. There will be no preliminaries this morning. We will now begin the program by the reading of a paper by Professor A. J. Cook, of the Biological Department of Pomona College. The title of that paper is, "Overwork—Neglect—Decadence." [Applause.]

PROFESSOR COOK. Mr. President: I heard a good story the other night that I am reminded to tell. A boy was at college and he came home all dressed up, had on his patent leather boots and his trousers properly creased, and he said, "Father, aren't you going to kill the fatted calf?" "No, my boy, I won't kill you, but I'll work some of that fat off of you." I thought last night that the fat will be worked off of you who have orchards if you carry out all the suggestions made. [Laughter.]

OVERWORK, NEGLECT AND DECADENCE IN OUR CITRUS ORCHARDS.

By PROF. A. J. COOK, Pomona College, Claremont, Cal.

Mr. President, Ladies and Gentlemen—Friends All: Where in all Nature do we see such excessive and persistent work as we annually witness in our citrus orchards? No rest period, and great crops, year after year, with almost no let up. The rose fancier dries off his ever-blooming favorites, that rest may bring more and finer flowers. Our deciduous orchards have their winter lay-off, and in addition, their off-years, usually each alternate year they are non-bearing. But our orange and lemon groves never ask for rest-periods, never clamor for off-years. In our best apple orchards, the trees, even with their rest seasons and years, are forced by their owners to moderation. The expert apple grower never leaves his trees to their own gauge of fruitfulness, but thins, by pruning and picking the newly-set fruit, that the trees may not be overworked and lose their thrift and vigor, and that the fruit may be large and of fine quality. I once heard Dr. James Law, the distinguished veterinary surgeon, discourse on milk fever. He urged that the just fresh mother-cow be fed sparingly for two or three days. Said he, "Parturition is a serious test of strength, springing the milk adds greatly to the burden, which, of course, is exaggerated by heavy feeding, and if added to this, the cow is forced to digest a full food ration, the burden is too great and she sinks under it." Here the heavy feed was the "last straw." May we not apply the same philosophy to our citrus orchards, and may there not be many "last straws" to press with crushing weight, in some of our cherished groves? Some of you will remember that admirable address by our Nestor in orange culture, Mr. C. C. Chapman, at the Seaside Institute at Long Beach, in 1904. You remember with what urgency

he insisted that every last detail of care and management should be most scrupulously observed. Did he not have in mind the magnificent performance of our citrus groves, and was he not pleading for the elimination of these last straws? The athlete is called to his utmost endeavor, as he enters the contest, and he knows that success only comes when he forces himself to observe to the utmost every rule of dietetics and hygiene. Our citrus trees are always heavily weighted with work. Shall we not stand between them and every extra burden? It is the overload that forces the stream to fling down its burden. Are we wise if we do not make every effort to prevent the overload in our citrus groves?

I do not believe that our best orange and lemon orchards are suffering decadence. Their owners are alive to every minutest detail of care and management, and the overload—the "last straw"—is pushed aside. As the highly bred Jersey, and the sensitive thorough-bred horse, must have and deserve extra care, so our wonderful citrus trees must have the best and most vigilant care of brainy men. With this, our citrus groves will increase in beauty, vigor, and productivity.

If there is decadence in some of our groves, and surely there is, I am sure that neglect is its parent. Are these great workers always well and wisely fed? Do any of us yet know just what and when to feed? Is the life-giving water always present in right quantity? Are the leaves and fruit ever stained with smut, symbol that the blighting insects are adding many and weighty straws? Professor Stubenrauch says there are seven packing houses in all southern California where the fruit does not need to be washed. Is there lack of coöperation that all may work together to stand off the frost-evil that threatens to crush our pets of the orchard?

In closing, I wish to emphasize one neglect that I believe is sometimes present in some of our well managed groves. I refer to faulty cultivation. I know of one large orchard in southern California that I have visited several times this summer, and always with increasing pleasure, that is a marvel of thrift, vigor, beauty, and productiveness. It is also a marvel of generous and deep, thorough cultivation, and that always close up to the trees. It should also be said that in this orchard are all kinds of soil from light sand to heavy clay, and with the great depth, so characteristic of our soils, even to less than three feet from bedrock. But everywhere the cultivation is well nigh perfect, and it is rare to find a single tree that shows any sign of decadence. Is it not imperatively necessary to the best thrift and vigor of our trees, and to their productivity as well, that our orchards show a deep, fine earth mulch all the season through? This is more to aerate the soil and to promote bacterial activity than to conserve moisture, important as that is. In clay soils, especially, where the land is low and flat, and more especially if there is any lack of perfect drainage, because of a heavy clay subsoil where the soil-particles are so likely to become cemented together, this thorough tillage close to the trees is all the more called for. This thorough tillage of our clay soils close to the trees is as important as is humus to the well-being of our orchards that are of a sandy constituency. Is not the reason why our groves on gravelly or even stony ground are often so surprisingly productive and satisfactory because they are so well aerated and so well drained? Are not some of

the blights, possibly, like "wither tip," gummosis, and "sclerotinia" induced or at least encouraged by this lack of proper cultivation? I feel sure of it. Show me an orchard that never knew smut, is well fed, is rich in humus, and properly irrigated, and, most important, thoroughly drained and aerated by always carrying a deep, fine, dry earth mulch, never less than four inches, better six, and you will show me a grove that very rarely will show any presence of blight or any evidence of decadence. This will require the heading of the trees high enough to cultivate thoroughly close to the trunks. I believe that Mr. Chapman is wise and sane in trimming his trees up from the ground so that the cultivation may reach very near the trees. Suppose that it does take a little of the bearing wood; goodness knows that the trees will do enough, and we make a serious mistake when we leave the earth hard and baked for a wide space about the trunk of the tree. The trees, by their colossal effort to swell the pocketbooks of their owners, have earned a right to all the soil and should not be forced to subsist simply on the limited area between the often too closely set trees. I am so sure that this ought not to be neglected, especially on low, flat clay soils, that I can not refrain from speaking with great earnestness, as I plead for better cultivation of the entire orchard, not omitting the space close about the trees. [Applause.]

MR. CALL. I feel that there are some questions presented by Professor Cook's paper that deserve more than passing notice. For one, I feel that citrus fruit growers should never be afraid of the truth in regard to the situation. I know that a great many have orchards for sale. I know that a great many have pride in the State and the county and the locality. I know a great many men are inclined to close their eyes to the truth, but it seems to me that our industry is so vital to us all that we should not be afraid to face the actual condition that exists.

PRESIDENT JEFFREY. Mr. Call, I understand that the committee on resolutions will present a resolution that will give you the opportunity of making this little talk where it will do the most good. Will that satisfy you?

MR. CALL. That satisfies me. There is another point in the Professor's remarks, and that is in regard to cultivation. In our colony we have abandoned deep cultivation and we think it proper. That was the theory a few years ago, but we have all abandoned it. We feel that deep cultivation injures the trees.

A MEMBER. What sort of soil have you?

MR. CALL. We have all kinds of soil in there, granite soil.

A MEMBER. How deep do you cultivate?

MR. CALL. We aim to cultivate about five inches.

MR. BLANCHARD. In regard to deep cultivation, my experience may be very beneficial. My oranges used to have famous keeping qualities. For years they have not kept well. It has puzzled me beyond anything, and I did not know what to lay it to. My foreman has been in the habit of putting the cultivator deep down, I think 10 or 11 inches, early in the spring. This last year I had another foreman and I told him not to cultivate deep and I had the best keeping oranges this year that I have had for years.

Now, in regard to fertilization. I made an experiment of this kind; I followed it up for three years. I put 15 pounds twice a year on a

certain number of trees. I put 10 pounds twice a year on a certain number. I put 20 pounds twice a year. I thought in three years' time I could determine. I found that ten pounds was not enough. I found that 20 pounds gave me a magnificent tree; it did not give me so much fruit, neither was the fruit so good, as where I put 15 pounds a tree.

MR. TEAGUE. I feel that there is a chance that we may perhaps get wrong on some of these things. May it not be that Mr. Blanchard may be wrong in attributing the good keeping quality of his fruit this last year to a change in cultivation? We all know that for several years prior to this last year the keeping quality of fruit in California was not as good on everybody's grove as it was this last year. I have a grove that has been uniformly—I think I am safe in saying—the deepest cultivated grove in California, 40 acres, and I think to-day it is in as good condition as any in California. I cultivate seven or eight inches deep, and sometimes deeper. This last year the keeping quality of the fruit was superb. The year before it was not so good. I did not change my method of cultivation at all. It seems to me it is not safe to say that the better keeping quality of Mr. Blanchard's fruit is entirely due to the change in cultivation. I have a grove situated only two miles from Mr. Blanchard's, in the same character of soil, and it seems to me there is a chance we may be wrong. I would not allow it to go out as an absolute fact that the good keeping quality of Mr. Blanchard's fruit is due to his change of cultivation. Those are things we have got to demonstrate, it seems to me. I know on our heavier soil we have to cultivate deeper. I have never been able to get a mulch that will hold moisture without pretty deep cultivation.

A MEMBER. Do you cultivate during the winter?

MR. TEAGUE. During the winter I grow a cover crop. The trees are eighteen years old. The soil is a clay loam of quite heavy nature. I will put my orchard up against anybody's for thrift.

A MMEMBER. Do you cultivate close to the tree?

MR. TEAGUE. No; the trees are lemon and naturally the lemon is a drooping variety. We have not trimmed up as much perhaps as I think we will in the future. I am inclined to think Professor Cook's idea is well taken, but I would not want to cultivate right up to the tree deep. I would not want to cultivate right up to the tree where the roots are near the surface.

MR. DEWEY. I have seen, perhaps, hundreds of orchards, and all of the orchards I have worked in where there is deep cultivation, we have our best trees, our best fruit and the most of it.

MR. JOHNSON. I came here to hear something about the die-back in orange trees. I came here twenty-seven years ago and twenty-six years ago this spring I set out orange trees. They have had the very best of care, but they are dying now. They have had lots of fertilization, lots of irrigation, lots of fumigation, and lots of elbow grease. They are right on San Bernardino avenue; any one can go and see them.

PRESIDENT JEFFREY. I will say that there are several people here who do not believe Mr. Johnson's story. They don't believe there is any decadence.

MR. JOHNSON. Well, they don't bear. The young trees have a big crop, just as full as they can hang, like blackberries.

MR. FREEMAN. I want to ask a question of Professor Cook. He attempts to make provision for an increased growth of the tree and an increased crop and yet he tells us there is an overbearing. I would like to ask how he would prevent the overload?

PROFESSOR COOK. I did not say that I would prevent it. I said we were going to have the overload, and for that reason we ought to observe every detail of care and management. It makes it necessary, I think, to cultivate deeply and pretty close to the trees.

MR. SMITH. I want to vouch for Mr. Teague's statement. I travel from one end of this State to the other, and I want to tell you that the 40 acres Mr. Teague has told you about is the best cultivated 40 acres in the State of California. It is the cream of every citrus grove in this State and it is the best producer, and I account for that production from the deep cultivation that he has had there for the last eight years. It is an ideal 40 acres, and the shallow cultivation in other places has caused lots of this going back.

MR. CROWELL. I feel that if we don't go any farther on this we fall short of the point. I agree with every word Professor Cook says, but I think he has stopped short of the point. He has been discussing good trees, trees that did not come from the sucker. Those are the trees that are not deteriorating. What we want to know is in regard to the trees that will deteriorate. I have a grove only three miles distant where I have both kinds of trees. They are about twenty years old. The orchard has had good care and all of the trees have had the same care; some of those trees are in fine condition and bearing well, and some of them are deteriorating and they are not bearing. If you spend the time discussing whether the Washington navel goes back to the Australian or whether the Australian goes up to the navel, part of you will go away believing one story and part another, and you will fall entirely short of solving the problem of deterioration if you do not discuss pruning. You do not need a physician for one who is not sick. The professor has been discussing trees that are not sick. I can take you out and show you trees that are sick. I was in Redlands last week and saw the orchard of a man who has been in the orange business nineteen years, and yet I saw great big suckers as large as my arm growing up from the crotch of those trees, forming a great umbrella on the top, and that sucker was of a nature which would not bear good fruit and it was of short life, and they had deteriorated and of course they had robbed the rest of the tree. I say that we ought to discuss the question of pruning. I at one time did not believe in pruning the orange tree at all, but I now believe in pruning it from the time you set it out from the nursery. The suckers will rob the rest of the tree; they are rank growers, and the real tree will be left in the lurch. I think if you will visit the Government orchard at Crafton you will see the remedy for this deterioration.

Now, one word in regard to fertilization. Two years ago I fertilized in the summer time. My grove improved from fertilization on the roots, of about half the grove. The other half I did not fertilize, and using that fertilizer in the summer wilted my grove. The half that I did not put fertilizer on did not wilt. I use more fertilizer than my neighbors and I do not argue against using fertilizer, but use it intelligently. We have a great deal of wilt in our colony.

MR. VAN LUVEN. There is just one question in connection with Mr. Johnson's grove. He doesn't make it clear how long his grove has refused to bear fruit.

MR. JOHNSON. They quit bearing three years ago.

MR. KUSTEL. Eleven years ago I bought an orchard that was not of much account. The trees were seven years old and it took eleven years to make a first-class orchard where every tree looked like its neighbor. The orchard is up here at Ontario; it is one of the best ones in the colony. That was done by paying attention to pruning, deep cultivation, plenty of fertilization and good irrigation.

MR. MACOUN. I just want to indorse every word of Professor Cook's paper. It is the keynote of success. The farming of to-day has brought around decadence in our orchards. It has brought about decadence in every part of the world where farming has been done and not in the proper manner. Cultivation had nothing to do with the fruit in the orchards that Mr. Blanchard spoke of.

PRESIDENT JEFFREY. Mr. Macoun, as you all know, has an opportunity of speaking this afternoon, and there is no one in the State that is more able to speak practically on these matters than Mr. Macoun. He speaks instead of Mr. Mills, and it is a pretty difficult proposition to take Mr. Mills' place.

MR. MUSSEY. I want to suggest a question in regard to aerating heavy soil. On heavy soil will the farmer get a sufficient drainage by putting in a tile drain, say two or two and one half feet; will it pay for the cost? I don't know of a single case in California where they use tile draining.

MR. MACOUN. I think Mr. Koethen has used tile draining. We have used them this year but the time has not elapsed that we can see any great difference in the rows of those trees.

PRESIDENT JEFFREY. The next paper will be by Professor Chase, of Fair Oaks, in the northern citrus belt, and his paper is entitled "Investigation of Citrus Subsoils." [Applause.]

MR. CHASE. *Mr. President and Ladies and Gentlemen:* At the wedding of Jupiter and Juno, the gods and goddesses vied with each other in bringing presents to the bride. Among them was Pomona, who brought a branch loaded with golden apples. These so delighted Juno that she ordered Pomona to plant them in her gardens. She instructed the Hesperides to take care of these apples and permit no one to take them, but these sisters grew careless and often were found eating the fruit themselves. To protect this fruit from being taken by gods and men, a terrible monster was placed at the gates of the garden. The fame of this fruit and the difficulty of securing it were world-wide. Eurysthenes sent Hercules to secure some of it. After a long and difficult journey he came to Atlas, who was the father of the Hesperides. He was at his post supporting the heavens on his head. Atlas agreed to help Hercules get the fruit. He was willing even to go himself if Hercules would take his place during his absence. After a few days Atlas returned with three golden apples. He decided that he would deliver them to Eurysthenes himself. Hercules feigned assent, but desired Atlas to do him a favor by holding the heavens till he could make a pad for his own head. Atlas, willing to accommodate him, placed the apples on the ground and took the place of Hercules; but Hercules, as soon as

he was released from his task, gathered up the apples and departed, leaving Atlas to continue his work.

The hundred-headed monster still stands at the entrance of the garden keeping the citrus growers of this State from realizing the full fruition of citrus culture. Now, we have come down here to Pomona to see if we can not get around that hundred-headed monster that stands between us and these trees. We have brought our Hercules with us, and we expect, and I have reason to expect, we are going to knock off some of the heads of that hydra-headed monster that stands between us and success. If you, as Atlas, lay aside your labors and help us get them and bring us the golden fruit, our Hercules will divide with you all and we will all share together. And he will do more. When we go home I think he will pull up those mountains that separate you from us, by their roots, and hurl them into the deep sea, and henceforth there will be, horticulturally, no north of the Tehachapi and south of the Tehachapi, but there will be emblazoned upon our banner, "California, the Golden State, for Golden Fruit, One and Indivisible!" [Applause.]

Now, I come from northern California and the conditions I talk about will be suited to that locality.

INVESTIGATION OF CITRUS SUBSOILS.

By Prof. Elmore Chase, Fair Oaks.

The orange tree in our land and in our climate is an exotic. May there not be some suggestion towards a solution of some of the problems that confront us by noting the conditions where the tree is indigenous and where it is exotic? We know that the soil of its home was very rich and very deep and that the trees grew to be centuries old, and from the meager knowledge we have, that the period of productiveness was continued with the age of the trees. W. D. Howells, in his "Indian Summer," describes the garden in Venice as having orange trees hundreds of years of age laden with fruit.

There is no doubt we have more orange climate than orange soil in this State. Our inquiry along this line of thought will be confined to subsoil conditions, treating of the root system physiologically and of the inert subsoil, that is, soil that contains or is capable of containing plant food which is unavailable. This will not include hardpan and such impervious material.

ROOT SYSTEM.

The root system of the orange tree is notably a great feed getter. It is capable of adapting itself to the work of taking from the soil all the food a vigorous and rapidly growing tree may demand, both for wood and for fruit. No root system works more energetically or penetrates with greater persistence through resisting difficulties than does this ancient sour root when budded to a navel orange. It must have space. When the tree has been planted in a hole made by blasting through hardpan and the root system has taken the food within this cavity and encounters the solid wall, it climbs upward till it reaches the soil above and enters this soil in search of food. Sometimes, in creeping up the wall of hardpan, it penetrates a crevice and in passing through this it flattens itself out, and after reaching the soil beyond it assumes its natural shape and keeps at work gathering food. Many instances have

been noted where the roots of a tree which descend into the ground with an angle and reach the depth where there is excessive moisture, will die at the end and the living end near the tree get a diminished supply of food. Immediately at this point adventitious fibrous roots are sent out. These creep along the dead portions just beneath the bark. These roots are so numerous that the bark is forced open and a temporary supply of food is secured. Every orange grower is familiar with these masses of feeding roots that come so near the surface if the soil is not stirred. This interesting character of the root system emphasizes the importance of deep soil supply of plant food.

Where hardpan is less than two feet from the surface, however rich and fertile the soil may be above, the root system hugs close to the hardpan, reaches out a greater distance from the tree, and sends up its mass of fibrous feeding roots to the soil above. With proper care such trees will produce an abundance of fruit many years, how many is not easily determined. It may be laid down as a fact that wherever the root system is repressed by soil conditions, such as hardpan, compact gravel, and inert soils, and these conditions can not be overcome, orange growing will be a failure.

There is one feature of the root system which should not be overlooked in this discussion. It may suggest some idea which will help in the solution of this problem. It is well known that the visible roots of the tree, however small, do not directly take the food from the soil. The real organs which take up the food held in solution in the water of the soil are very minute root hairs. These are coexistent with the foliage. On deciduous trees, when the leaf has ceased its functions, the root hair also ceases. These root hairs are deciduous with the leaves. In the absence of these the root is no longer capable of taking in food. This is the case with all deciduous trees. They are dormant for a period of time and that time is when the weather conditions are not favorable to the growth of the trees. The orange tree is an evergreen and except in northern climates never ceases to grow. Its root hairs or feeding organs are always present and active. May it not be that by this activity the orange tree may suffer more by the vicissitudes of soil and climate? Is it not exposed to dangers which the deciduous tree escapes? May not this difference in the action of the two root systems, the evergreen and the deciduous, suggest methods of treatment which recognize this condition of the feeding organs of the orange tree?

SUBSOILS.

The principal function of soil is to hold plant food in store for the use of the plant. A fertile soil is a soil that has in it, or is capable of having in it, plant food to be supplied to the plant on demand, hence any soil qualified to take plant food on deposit, and hold it subject to the demand of the root system, may be considered fertile soil. It is a rich or a poor soil according to the amount of available stock it has on hand. An inert soil is a safety vault locked up and the key lost. It can not receive, deposit, or pay out what it may have in its possession, but recent investigations in soil bacteriology have demonstrated that there is but little soil which can not be made fertile.

The question of inert soils in the Sacramento Valley is a new one. It is not strange that these soils so compact, impervious to water, which

have been undisturbed for unknown ages, are considered unfertile and of no more use to the tree than so much hardpan. There are very large areas of such soil capable of becoming quite rich in plant food. This soil can become useful by some methods of cultivation and by means of fertilization. The investigation of such soils is so recent that but little knowledge has been acquired concerning them, but enough has been done to lead to some suggestions and create a new interest in soil studies. A brief reference to a few typical cases is all that can be given in this paper.

A ten-acre tract of land with a depression running diagonally through the field is a case in point. The land on both sides slopes gradually towards this depression. On one side the higher portion is underlaid with hardpan or impervious soil. The examination was begun to determine why the trees in the lowest portion were unthrifty, dwarfed, and dying. The soil was found to be of good depth and fertile for two feet. Below this was a substrata of compact soil which prevented drainage. The ends of the roots of the trees were found to be decayed, such as would be the case with excessive moisture. The examination of these roots showed the sending out of adventitious roots beneath the bark as mentioned above. There was no disease connected with any tree except some slight evidence of gummosis, which, however, is not a disease. The following remedy was prescribed: Early in the winter a surface drainage ditch was to be made through the lowest portion of the hollow for the purpose of draining the surplus winter rains. The trees were to be severely pruned back, a good coat of stable manure plowed in in the spring, and deep cultivation to follow. The summer irrigation was to be moderate, and care was to be taken that no more water was allowed on the side hills than could be retained in the soil. The result was that every tree thus treated sent forth during the past season a marvelous growth of wood. The new life given to this half acre of dying orange trees was in no way due to the action of the inert subsoil; but it is evident unless this subsoil can be brought into activity, the productive period of all of these trees is limited to a few years.

In another class of subsoils, though not wholly inert, owing to the compact nature, the fertility is very low. The trees were planted with very great care. Very large excavations were made and filled with surface soil. This grove, from fifteen to twenty years old, has been yielding moderate returns and is still in a very fair condition, but the trees show they have reached the limit of profitable orange growing. There is neither soil nor food enough.

Another type of soil quite common in this valley is seen in a ten-acre tract of a heavy clayey soil, but very rich in plant food and seems well adapted to growing the orange tree, but between this upper soil and a subsoil is a shallow layer of hardpan. This tract was planted twelve years ago and at six years of age the trees, though bearing quite heavily for their size, ceased to show signs of further improvement. After changing owners three or four times, it was bought by the present owner. His thorough cultivation began to make improvement. He found many trees failing to respond and some were dying. They had all been planted in holes blasted out by dynamite. The tap root would go down to subsoil, but the trees as a whole were slow to respond to better culture. The owner dynamited the whole tract between the rows where the hard-

pan existed and completely broke it up. By adding various fertilizers and by careful cultivation these trees, now twelve years old, are most of them considered large trees for their age, and are bearing a profitable crop of oranges and have been for the last five years.

These examples are enough to suggest a very important idea. Unless soil has the depth of two feet or more above hardpan or any unfertile subsoil, citrus culture will not pay for the outlay as well as some other fruit. Hence it is of the greatest importance to all who think of growing citrus fruit for profit to examine thoroughly the condition of the soil even before money is invested in its purchase. This is especially important in planting orange orchards. If the soil is of good depth and any hardpan or impervious soil beneath this soil is capable of being broken up, then it can be made a good investment. It is the want of capillarity in soils that renders them inert or infertile. In order to bring all soils into first class condition for the growth of plants of all kinds, we must increase the capillary attraction of the soil, make it porous, capable of receiving and delivering air and water. We have two very efficient agents for producing this result, one mechanical and the other vegetative.

Then the following directions are given to render the soil suitable for the growth of the exotic golden apple tree: First, let the land be surveyed and staked for tree planting. Make a plot of the land and then dig the holes for all the trees very wide and very deep, shooting them with dynamite wherever needed till a complete drainage is obtained. Then let the holes be filled with good soil so that the surface when settled shall be even with the adjacent ground. Give this soil, whether hardpan or compact soil, a thorough plowing with dynamite everywhere between the holes. This should be followed by a very deep plowing with no less than a strong four-horse team, and it might be well to give this a subsoil plowing with a still stronger team. The irrigation system should then be established and the whole field thoroughly prepared for alfalfa growing. Keep this in alfalfa not less than five years, when its root system will be down deep in the ground penetrating the inert soils.

Such a preparation for planting will secure at the age of ten years an orange grove giving larger returns than is generally received from a fifteen-year-old grove planted in the ordinary way. During the first five years this field, according to F. Q. Story, president of the California Fruit Growers' Exchange, will be producing the safest and most remunerative of all crops grown in California. The work of preparing the land after the period of alfalfa will put the soil in prime condition, with abundance of fertility sufficient to bring the trees to bearing. The depth of such a soil will give absolute freedom to the root system and enable the soil to hold and assimilate any amount of fertilizers that the grower may deposit. The trees may be given such a bank account of stock that we may have good reason to expect a period of undiminished fruitfulness for more than one generation. All our planted orange groves may have this infertile soil brought to activity by degrees, by deeper cultivation not too close to the tree, and by using dynamite freely, and growing during the winter season cover crops which have long roots. Stable manure fertilization, along with the deep rooted cover crop, will make rapid progress towards quickening to life

activity the compact inert soils in our existing orchards. The best means, however, is the cover crop. The more this is used the more efficient it becomes. The large increase of productions per acre in Europe after centuries of cropping the soil, is an object lesson in promoting the development of the inert subsoils. [Applause.]

MR. LAIDLAW. I think this is one of the most important papers we have had before this convention. After growing oranges for fifteen to twenty years, my observation is that the old orchards are going back—orchards that have been planted on shallow soil. The reason for their going back can be explained in various ways—if a man falls down on his irrigation or cultivation or fumigation. I believe that one thing has not been mentioned so far in this conference that has more to do with the deterioration of our groves than anything else, and that is the use of distillate spraying seven or eight years ago. They were sent on the downward path by distillate spraying.

MR. FREEMAN. I would like to ask this: When can we have that paper on frost?

PRESIDENT JEFFREY. We are not going to have it at all. Professor O'Gara promised me that he would have that paper for us, and he was so anxious to do it. But the day before I left he wrote me that he had now gone into the service of the Association of Fruit Growers of the Rogue River Valley.

MR. BODENHAMER. Could you not secure that paper from this gentleman and have it published in your report?

PRESIDENT JEFFREY. I believe I can.

MR. BARNHART. I move that a rising vote of thanks be tendered Mr. Chase for that very excellent paper. I think the convention will agree with me that that paper is of sufficient merit that this convention show its appreciation by a rising vote of thanks.

The convention rose, with cheers.

MR. CHASE. I thank you. I want to say just one word more. In Europe, where they have planted soils for ages and ages, they are raising larger crops every year than they raised years ago, and it is by this method of getting down.

MR. TEAGUE. There was a fact in regard to the planting of our groves that came to our attention recently which I would like to call attention to that may throw light on the condition of some of your groves in regard to decadence. We had some spots in our grove that were not looking right, and we were at a loss for some time to determine the difficulty; they were surrounded by as thrifty, vigorous trees as you ever saw. The soil is excellent, no hardpan, of good depth, 50 feet deep, perhaps, so there is no bad soil condition whatever. We finally determined to make a survey of the ground to determine the grade. We irrigate by the furrow system of irrigation. That survey developed this fact, that every spot that we had in the grove where the trees were looking yellow and were ceasing to bear, the grade in the direction in which we irrigated was too flat, that it would run below a fall of six inches in a hundred feet; and in every case where the grove was looking in good condition it had a good grade in the direction we irrigated, in some places as great as three feet in a hundred. We feel certain that the condition of those trees in those spots is due to the fact that those trees, in order to give other parts of the same rows sufficient quantities of

water, had received too much water, and I believe here in California we pay too little attention to the grade in our citrus orchards. You may have a beautiful piece of land, but you may plant it wrong. I used to think if a furrow would stand up full of water and just gradually move through, it was an ideal condition. I believe now the more grade you can give your furrows and not wash the land, the better. Some soils you can give twice as much grade to as others. We had a little section of our grove, on this same sort of soil, where the ends of the rows flattened out, and in order to get enough water in the winter time, the storm water in the winter would settle in there, and in irrigating, in order to get the water across that place, we had to run it a long time, and we found that in that flat place nearly all the trees turned yellow, later got gum disease, and we lost thirty-five trees. We changed the system of irrigating so as to give it less water and not allow storm water to get in there at all, and those trees all recovered from gum disease and are now thrifty trees.

PRESIDENT JEFFREY. I will ask Mr. Call to come forward and speak on the subject assigned him, "The Treatment of Gum Disease." I wish to pay just one little tribute to the Pathological Station at Whittier, by remarking that in my opinion it gave the first impulse to the plan that is now going to be discussed.

TREATMENT OF GUM DISEASE.

By A. F. CALL, Corona.

MR. CALL. *Mr. Chairman and Fellow Growers, Ladies and Gentlemen:* It is with a great deal of diffidence that I speak on any subject of horticulture or the care of trees, because I know that conditions are so different in the different localities, and the treatment required for different groves and different locations and at different ages is so diverse that it requires a man of very long experience and larger ability than mine to give any general advice. But this matter of gum disease is one that interested me very particularly, as I had about 1,600 trees affected four years ago, and so I gave it some study by going to Florida and into the different portions of California to make a study of it, and spent about a year in experimenting. I, perhaps, should say that I ought to have reduced this to writing and had it in the form of a paper so it would be better reading, but my time has been so occupied since Mr. Jeffrey invited me to talk on this subject that I have not been able to do it.

In my investigations of the gum disease I found at least two distinct troubles, and I want to make it clear as to which I am speaking of. I found a disease of the lemon tree and which affected some orange trees, the characteristics of which were a gathering of the sap under the bark, making blisters and pockets of sap, which, by evaporation, I suppose, was afterwards reduced to gum and broke its way through the bark and flowed down the tree, usually at a distance of about four inches to a foot above the ground. I also found that another form of the gum was the breaking out in small globules or bits of gum, from orange trees in particular, affecting the trunk and the limbs of the tree, causing a roughening of the bark and a rolling up of the bark, that is commonly called scaly bark of the orange tree.

I want to speak first of the lemon gum, as we will call it, although it does affect orange trees as well, because I am more familiar with that and the trouble is more obvious and the difficulty is more easily overcome. I found that this gum was most prevalent where the drainage was imperfect and where sediment had been permitted to pile up around the trees, such as a little depression in the orchard that had not been filled before the tree was set, so that after irrigation, in forming the grade that the water naturally forms, the earth had been piled around the trees a little too high, or where the trees had been set a little too deep. Most of the trouble came from the foot of the grove where there was a depression and somebody had let the waste water from irrigation accumulate some sediment. I tried first to demonstrate to my own satisfaction that this disease was not contagious, not bacterial, and I think I demonstrated that completely by inoculation. I took the worst gum I could find, from the rottonest trees, and opened the bark of a great many live trees, inserted the gum under the bark, tied it down, and I was unable to produce any gum in those trees. I then endeavored to produce the gum, and I found I could produce it in a very short time in a great many different ways. I found that I could produce it by putting some strong manure or fertilizer around the trunk of the tree; or I could do it by putting on an excessive amount of water; and I could very easily do it by taking a little wooden hammer and hammering a little spot on the trunk. The gum would form in two weeks. You did not need to break the bark; just hammer it so it would deteriorate. I then concluded that gum was caused by a cultural condition and that the cause of it was a deadening of the member, destroying its sap-carrying power which stopped the down-flowing sap, forming pockets of clear sap; and I will say in that condition we took gum and had it analyzed by chemists and it was pronounced simply sap and nothing else. These pockets of sap, unable to pursue their way down the tree, were compelled to remain there until the water evaporated and left this gum, and that stayed there until it rotted its way out. If that is permitted to continue, of course it will go around the tree and girdle the tree and kill it. In experimenting with the remedies, I found that these trees could be very easily cured; and I want to say here, I don't want to take credit to myself for this, wholly, because a great many of us were working together. My foreman and Mr. Jamison and Mr. Hampton and Mr. Griffin and different ones have contributed in large measure to this, so I should say *we* found this out. We found that what we needed to do was to let out that sap or gum as soon as we could, and the way we did it was by making little furrows down the tree, not too many and not running together, perhaps not nearer than an inch and a half apart, maybe two inches apart on a tree largely affected. It is important to go as high as the limbs so a gum will exude before it forms a pocket or becomes destructive to the tree. Then we found that by oiling the bark we could hasten its recovery, and we wanted to use an oil that was softening. The worst thing to use is crude oil or crude oil and carbolic acid together; that destroys the bark. What we want to use is a soft animal oil, lard or neat's-foot oil, and we all found that neat's-foot oil was the best, so we applied that liberally, two or three applications two weeks apart. And then, to protect the bark from baking we whitewashed the trunk of the tree, because we frequently were compelled to

let the sun in. The proposition is this, that you have got to have enough bark to carry the sap, and this gum pocket usually comes from a very healthy tree, carrying much sap. The injury has come from various causes, mainly from the piling of sediment around the trunk of the tree, or by water, or by redwood stakes that have been pulled up, that the tree has grown around, or by stones that have been gathered in by the roots and absorbed by the tree. There are various ways in which this can be caused, but anything that affects the tree is that portion of the bark extending from the crown roots up above the bud. That bark was intended by nature to be exposed to the sun and air, and when it is not so exposed it deteriorates. The surface of the root is hard; it is impervious to the acids of the soil, but when you take that portion of the bark that nature intended to have exposed to the sun and air that is covered with that earth, you have nothing there that will protect the bark from the acids of the soil; it immediately gets brown and deteriorates. Then you have the condition of a big top which puts forth and uses a great amount of sap, returns a great deal of sap to the soil and a narrow channel in which to return it, because it has been partially injured by the gum; you have not enough bark left to carry the sap to the ground, and so it is necessary to cut off a part of the top. For instance, if you had a half-inch pipe and you are trying to carry a big amount of water through a two-inch pipe above and you could not carry it down and it was overflowing, you would either have to enlarge your outlet or shut off your source. You can not enlarge your outlet all at once, so the only way to overcome that gum is to cut off part of your top. Right there is a fact which I don't know how to explain, and that is, if you cut your top off even all around it won't do any good, but you have got to cut your limb clear back to the trunk. Mr. Griffin has cured their entire grove by this method and he will agree with me in saying that you have got to cut your limb back to the trunk. We found that absolutely important and vital, because that stops the flow of sap down through the destroyed part of the tree and gives it a chance to heal up. In a lemon tree, cut from the big limb that is right over the gum spot. In a year or two it will heal over and you will never feel the loss. A lemon tree is different from an orange tree in this.

Right here I want to say that I am not a scientific observer and I have no scientific education, but I have found from observation that the sap-carrying cells of a lemon tree run right up and down. You find trouble with a lemon tree and you will find it right straight down, but in an orange tree you can find it any old place. That is, apparently. I say that with some diffidence because I don't know that to be a fact, but I say apparently so, because I find the difficulty in an orange tree on the opposite side from where the trouble appeared on top.

The next thing to do is to remove the cause, and the best way to remove the cause is to establish drainage. You can not cure it unless you establish drainage. The next thing to do is to clear the earth away so that you can expose the crown roots so that the air can get at them, and see that the water does not settle around your tree or the sediment does not form around your tree, and if you do that, in time you will save your trees. I demonstrated to Professor Ralph Smith that you could save a tree that had only an inch of bark left. Now, there are about four inches of bark almost going around the tree and the tree is

bearing heavily. It can be done when you have got down to a very narrow proposition, and I think I can say with perfect safety that this will absolutely cure the gum disease on lemon trees, because Mr. Jamison has done the same and Mr. Leffingwell. I have never heard of a failure where these directions were faithfully carried out. There might be a case where you could not get drainage that you could not get the results, but where you get drainage you can save your lemon trees.

A MEMBER. There is one point that I would like to have you make a little clearer; that is, the point of the cutting back of the tree. Frequently, one half the tree may be diseased and the other half look healthy and good. How do you cut that back?

MR. CALL. I cut that back to the trunk, whether it shows it or whether it does not show it. The big limbs clear back to the trunk should be removed on the side on which the gum appears.

A MEMBER. I am astonished at that, because we followed that method without good results. We found that the diseased part came back and the good part came back, all alike.

MR. CALL. None of us have had that experience, and I think it must be due to the fact that your tree was not badly affected.

A MEMBER. Some of them did not have more than two or three inches of bark.

MR. CALL. I compared that with Mr. Griffin. I had about twenty acres to cure and he had over a hundred. When he first came up to Corona to study into the matter and formulate his methods, we didn't have that point in our mind and didn't give any advice on that. We were pursuing the same method he was, pruning around all over the top, lessening the side of the top evenly, but we discovered that the other way was the best in our groves, and when I was done talking with him he said they had changed and were cutting back to the trunk. But perhaps your experience is as valuable as mine, but that is my experience and the experience in our locality.

Now, with regard to scaly bark on the orange tree I am not so clear, and I would not want to say with any great certainty as to the cause or the cure. I can only give you my experience. I had 400 of those trees in my grove, mostly among the older trees, and I investigated the roots of each one of them. I put a careful man at it and had him go down to the roots, and in every case but two I found what we thought was the cause. It was usually a stone buried in the tree or covered in by hard sediment that had formed around the tree from silt that had got hard, or by a redwood stake, or by a crossing of the roots that stopped the circulation, and in a few cases bad crossing of the limbs had caused it. We removed what we supposed to be the cause. Where we found a stone buried in the roots of the tree we hammered it out, or took up a stake, or took out cross limbs. We pursued the same remedy we did with the lemon trees; that is, we dug away, exposed the roots, oiled with neat's-foot oil, furrowed the front of the tree. Where we found a yellow color we cut it out, and I have lost four trees out of 400; the rest got well; the scaly bark entirely disappeared. So I feel that I can say that I have an opinion that it is local trouble with the tree, and that it is more frequent in a piece of sodden ground than in a piece of ground where the soil is loose. I have given this experience to several, and some have reported to me that their trees had recovered. I have had reports from but few on this branch of the trouble.

MR. BARNHART. I have an orange grove under observation, the one that has produced $700 worth of fruit net for two years, and, unless my judgment fails, that orange grove is doomed from the very disease that you speak about. It is growing in sandy soil and as soon as this convention is over I am going to see that grove immediately; but what I want to know is what kind of soil you grew your trees in.

MR. CALL. I had different kinds of soil, but the groves I had the most trouble with were in a sandy soil with stone in it, and the grove that I had next to the worst was a gravel and clay soil. I didn't have any of that trouble where it was loose and free from stone.

MR. GREER. How long after treating the trees does it take to cure them?

MR. CALL. I didn't see much improvement in the orange trees for a year. In the lemon trees I saw it in a month; I could see that it had stopped spreading, and in a year it commenced to smooth up and at the end of two years you can't find a mark on them.

MR. GREER. I have done the same thing a year ago, and while the gum is gone the trouble is still there. I have tried everything that has been recommended with no success. This is the only thing I have found success in. Each limb is practically supplied by certain roots. When you have cut off that limb you have cut off the cause. If there are obstructions in the roots the sap must break out. There is where your cross roots or rocks cause trouble.

A MEMBER. You spoke of making furrows down the trunk of the tree. Will you please tell me the width and depth of those furrows?

MR. CALL. We took a little blacksmith's paring knife, a thin bladed knife, and doubled it back on itself so as to make an acute angle in the blade and getting a furrow about an eighth of an inch wide and clear through to the wood. The gathering of the sap is between the bark and the wood. We didn't put them any nearer than an inch and a half apart; four to the tree would answer.

MR. WOOD. Do you think it would be advisable to fill up that place around the roots with anything after the dirt is taken away?

MR. CALL. We haul river sand. We let them stand open for a year and fill the place up with sand.

MR. WOOD. I did that same thing. On 600 trees I had 110 cases. I don't think there is an active case in the orchard now except two or three trees that were so far gone they died. Another source of the gum disease would be a place along the body of the tree where you might have cut out a limb. I saw a case of that kind this morning at my orchard; my man called my attention to it. I have seen that a good many times, and I would ask Mr. Call if he would not coincide with that?

MR. CALL. I think anything that would stop the flow of sap would cause it.

A MEMBER. My soil has no rocks. It is a heavy soil, has good drainage; the drainage is almost perfect. I would think from your talk it must be hard ground around part of the tree, perhaps, that would cause the gum disease. It is sufficient to take the soil just around the tree.

MR. CALL. Expose the crown root for a year. Put in something to take the place of the hard clay around the roots.

A MEMBER. How about the temperature of the oil at the time you apply it.

MR. CALL. We use it normal.

A MEMBER. How soon do you put the oil on?

MR. CALL. I do it at the same time when I cut the tree.

MR. PAINE. There is a question that Mr. Call did not feel qualified to answer and I would like to have you refer it to Mr. Parish, this question as to the structure of the orange and lemon, as to their difference in structure, so we can know why it is difficult to know which limb to cut off. I wish when you get his answer you would incorporate it in the report.

PRESIDENT JEFFREY. I am sure Dr. Parish will be able to explain that, and we will have it incorporated in the record.*

A recess was here taken until 1:15 o'clock p. m.

AFTERNOON SESSION.

PRESIDENT JEFFREY. The convention will please come to order. I wish to thank the members of the convention for the extreme courtesy you have shown the chairman. With 700 or 800 people in the room, if there were any contrary delegates it would be hard to control the convention. Now, we will have a paper on a very important matter. It will relate directly to the mottled leaf of the orange. The paper will be presented under the head of "Our Knowledge of Chlorosis," by W. S. Ballard, Mr. Ballard being connected with the Bureau of Plant Industry, Department of Agriculture.

MR. BALLARD. *Ladies and Gentlemen:* Before presenting this paper it might be well to offer a few words of explanation. The subject of chlorosis in citrus fruits has never been investigated to any great extent, and, therefore, we have no great amount of definite knowledge. When the subject is assigned to a pathologist to investigate, his first duty would be to determine what has been done and what is known in reference to chlorosis in other plants, and also to acquaint himself—which, of course, he should do beforehand—with the number of physiological processes that are going on in the normal healthy plant. It is with the idea of presenting to you the subject in somewhat the way he would take it up that I have prepared this paper.

OUR KNOWLEDGE OF CHLOROSIS.

By W. S. BALLARD, Bureau of Plant Industry, Washington, D. C.

Before taking up the discussion of the subject of this paper, let us note first some of the characteristics of a healthy tree and review briefly a few of the fundamental processes in operation, noting some of the results that are obtained when these normal conditions are disarranged.

The first thing that strikes the eye in looking at a tree is the color of the foliage. The normal color of orange foliage is deep green. This is

*Dr. Parish states, in answer to this question, that he knows of no structural difference or arrangement between orange and lemon tree cells. He suggests that the whole trunk of an orange tree may have a tendency to grow in a spiral form and the lemon a tendency to grow straight. This would in a measure be in accordance with Mr. Call's observations.

due to the presence in the cells of the leaf of immense numbers of little green bodies which we call chloroplasts. Chloroplasts are small proteid corpuscles impregnated with a green pigment called chlorophyll, a word meaning "leaf green." Our present discussion is concerned largely with the functions of these chlorophyll bodies, or chloroplasts, in the process called photosynthesis. "Synthesis" means a putting together, and "photo" refers to light, hence photosynthesis is a constructive chemical operation which is brought about by means of sunlight. Briefly stated, carbon dioxide, or carbonic acid gas, from the atmosphere diffuses into the inner tissues of the green leaf, and water is brought up to these same tissues from the soil; then, in the presence of sunshine and chlorophyll (the green pigment of the leaf just mentioned), a chemical reaction occurs, and the carbon dioxide and water unite to form such complex substances as sugars and starch. Photosynthesis is, therefore, a chemical process by which the raw materials, carbon dioxide and water, are caused to unite chemically to form sugar. Neither sunshine nor chlorophyll alone is capable of bringing about this union, but sunshine in the presence of chlorophyll causes the reaction to take place quite rapidly, and to this manufacturing process the term photosynthesis is applied.

The extreme importance of this operation is evident when we remember that practically all the sugars and starch and other carbohydrate foods that we eat have their ultimate origin in this process. These substances are the food materials from which the cell walls and woody portions of the orange tree are built up by the living protoplasm. We see then that the growth of the tree, as well as the growth and production of the fruit, is particularly dependent upon the normal operation of the process of photosynthesis, and hence it is necessary that the foliage be in a healthy condition.

When the green color is replaced by a sickly yellow color, growth of the tree and maturing of the fruit is affected because the starch and sugars which are required as foods for growth are no longer being produced in sufficient amount by the defective chlorophyll.

The carbon dioxide used in photosynthesis diffuses into the leaves through small openings which are present in great numbers in the epidermis or outer covering of particularly the under surface of the leaf. The water necessary in the process is taken up from the soil, passes up the framework of the tree, and out into the leaves.

With this soil water come fertilizer elements and other soluble substances from the soil. More water than is required for photosynthesis is thus brought to the leaves, and the excess passes off largely in the form of water vapor gaining exit chiefly through the same openings by which the carbon dioxide enters. The fertilizer elements and other substances brought up in solution can not volatilize, and hence we have the stream of soil water passing up the framework of the tree and out into the leaves, there to be evaporated and leave behind some of those substances which are brought up from the soil. Thus a sort of boiling down process goes on. It has been estimated that a birch tree with about 200,000 leaves gave off something like 100 gallons of water during a single hot day, and a 115-year-old beech tree averaged nearly twenty gallons per day for the period from June 1st to September 1st. Obviously, then, a small amount of any deleterious substance taken up in

the soil water may by this process accumulate in sufficient amount in the leaves to completely disarrange their normal operations.

For while the process of absorption of soil water by the root system is by no means a simple sucking up operation, and is governed to an extent by a selective power of the living roots, yet deleterious substances can not be entirely eliminated. Indeed, deleterious substances in the soil water may act immediately upon the root system itself in such a way as to disarrange this absorption process, and the result may manifest itself in the loss of the healthy green color of the foliage. The interrelation of processes operating within the plant is so intimate that an effect observed at one end of a chain may have its ultimate cause in some unexpected factor operating at a far distant point.

Now, with more particular attention to the subject of this paper. Chlorosis may be defined as that pathologic condition of the foliage that obtains when the chlorophyll loses or fails to develop its normal green color. In extreme cases, as probably every orange grower has noticed, the green color is absent entirely and the leaves or spots in them are practically white. Between this extreme condition, and the normal green of healthy leaves, all gradations of yellows and light greens exist. The term chlorosis is, therefore, a general one, and has reference to that pathologic condition of the chlorophyll just described, regardless of how that condition is brought about and whether it be in oranges or other plants. A number of causes may operate to induce it. It was early recognized that iron is an important factor in the development of chlorophyll. It is known that iron does not enter into the composition of the pigment chlorophyll, but it is equally certain that when iron is entirely absent the plant is not capable of developing this green coloring matter, and the leaves remain white or yellowish. The amount of iron actually needed for chlorophyll production by the plant is very small, and in view of this fact it would seem doubtful if soils ever exist that do not contain an abundant supply. This would seem true even in spite of the fact that the application of iron salts to the soil, and as sprays applied to the foliage, has been materially effective in alleviating chlorosis of grapes in France. I will refer to this again.

When nutrition is disturbed chorophyll may fail to develop, and by some the dependence upon a supply of iron is thus explained. The nutrition factor is undoubtedly a very important, if not the all important one, and a number of causes may operate to so disarrange nutrition as to bring about chlorosis.

Starch, one of the food products which we have seen is manufactured in the green leaf, is insoluble in water, so in order to be transported to other parts of the plant, it must first be dissolved. The starches which we eat are acted upon in the mouth and intestines by certain substances called enzymes, which dissolve them and convert them into soluble sugars. A similar process occurs in the plant. The excess of starch which accumulates in the leaf during the sunshiny hours of the day is later dissolved by an enzyme and converted into soluble sugars, and so transported to other parts of the tree, to be used in growth and the production of fruit, etc.

If for some reason the dissolving of this starch is prevented, its very accumulation soon reacts in a way to cause the disappearance of the chlorophyll which took part in its production.

Now it happens that beside the starch dissolving enzyme there are present in the leaf others which we call oxidizing enzymes, and it appears that these oxidizing enzymes are capable of destroying the starch dissolving enzyme.

Tobacco, in certain localities, is seriously affected by a type of the disease chlorosis, and while the problem is by no means settled satisfactorily, it has been suggested that the train of coordinated factors responsible for the disease may be something as follows: An excessive nitrogen accumulation disarranges the nutrition process in certain leaf cells; this induces an excessive development of oxidizing enzymes, which in turn destroy the starch dissolving enzyme, and with the destruction of the latter there is no means of removing the starch supply when formed, and soon its accumulation reacts in the way mentioned before, to induce the disappearance of chlorophyll. Thus starting with a disarrangement of nutrition we end with chlorosis. Whether this explanation is correct or not we are not sure. It is possible, however, and I have mentioned it to call attention to the complex nature of the problem, chlorosis.

Finally, we should mention calcium carbonate, or limestone, as a soil factor capable of inducing chlorosis. Serious losses from chlorosis have been occasioned in the vineyards of France, and so far as treatment is concerned the grape has probably received more study than any other plant affected by this type of disease. Grapes in France are not affected except when growing on limestone soils. Chlorosis can be readily induced in normal healthy vines growing on non-limestone soils by placing powdered limestone in some form about the roots. Hence, it is generally accepted that an excess of limestone is the responsible factor.

Without stopping to discuss the various experiments that have been performed we may state that the application of a solution of iron sulphate to the soil about five to ten ounces in two and one half gallons of water, and in bad cases a supplementary spraying of the foliage with a one per cent solution of the same substance, has been the most successful single remedy. Some prefer to use commercial nitrogen fertilizers along with this treatment. The application is made in the spring, and the chlorotic foliage begins to take on its normal green color in a relatively short time.

We have called attention to the necessity of iron in the development of chlorophyll, but we know that the amount required is very small, and it has been shown that vines frequently become chlorotic when growing in soils containing an abundance of iron, as shown by soil analysis. Soil analysis, however, does not say much with reference to the availability of iron, *i. e.*, it may be present in abundance and yet not be in a form that can be taken up by the root system. All in all, it seems somewhat peculiar that iron salts, and particularly the sulphate, should be so effective in overcoming the trouble, and we are not able to satisfactorily explain its action. When applied to the soil it possibly reacts with the limestone to render the latter inactive, or it may reduce the alkalinity of the soil. The explanation of its beneficial effect when sprayed on the foliage is probably to be sought elsewhere. It might possibly be that this treatment would prove beneficial to chlorotic citrus trees.

With reference to the distribution of chlorosis in the United States it should be noted that it is a very common trouble in one form or

another throughout the arid West, and is not by any means confined to citrus fruits or even to tree or bush forms. Such plants as the tomato are frequently attacked. In Salt Lake City and vicinity it is common on peaches, pears, and apples, and is very noticeable on introduced ornamentals, and particularly on Lombardy poplars. The latter may completely succumb to the disease. In the San Joaquin Valley peaches are frequently attacked. I recently saw a badly affected block near Stockton. The trees growing along an irrigation ditch running through the orchard were more seriously affected than the rest. Apricots are frequently subject to the mottle-leaf type of chlorosis, but apparently do not suffer so much as peaches. I have examined some of the mottle leaves from apricots, and have found starch more abundant in the unhealthy than the healthy areas of the leaf, obviously an example of disarranged nutrition as mentioned before.

Among citrus fruits it has been my observation that there are at least two types of chlorosis. First, the mottle-leaf, variegated, or calico-leaf type, in which the chlorotic areas are in blotches between the lateral veins; and, second, the general type in which the whole leaf becomes uniformly yellow.

The first type may at times grade into the second. The type appearing in vigorous growing suckers springing from severely topped trees is probably a modification of one of the above. It might be noted here that the chlorosis of the grape, which is amenable to the iron sulphate treatment, is more nearly like the second or general type on citrus trees. The mottle-leaf of citrus trees is similar to a disease called variegation, and its cause and treatment may possibly be different from that of the general type.

Some species of the citrus genus may be characteristically resistant to chlorosis, just as among the grapes one species, *Vitis Berlandieri,* is not subject to chlorosis when growing in abundantly calcareous soils in which other species are killed by the disease.

I realize that this whole discussion has been anything but satisfactory to one who has listened for a solution of the problem. Problems in physiologic diseases are usually of an obscure nature, and since the whole subject of plant physiology is comparatively young, our information is not as complete as we might wish it to be. A new problem is, therefore, likely to open up a new field which has to be carefully explored before definite conclusions can be arrived at, and in the present discussion I have attempted to present the matter in a way to call attention to the complexity of the problem. We have seen that the disarrangement of one physiologic process may set in motion a long series of disarrangements, and in the end arrive at possibly an unexpected result. Chlorosis of citrus trees may be the final outcome of a long series of derangements, and we fail to recognize that anything is wrong until the end result arrives. The disease is usually, no doubt, due to a soil trouble, and if it is not due to an excess of lime then possibly some other factor, as the magnesium chloride ratio, to be discussed in another paper, or a combination of factors, that we have hitherto disregarded may be responsible, for besides the chemical aspect of soil problems, we have the physical and the biological, both large fields, and in addition we need to know the bad as well as the good results obtaining from the fertilizers, irrigation and cultural methods we employ. [Applause.]

PRESIDENT JEFFREY. Now, we will have another paper on the same subject, by Mr. R. R. Snowden—"Proportions of Magnesia to Lime in Relation to Nutrition." This paper will to read by Mr. Edgar A. Wright, of Los Angeles.

THE PROPORTIONS OF LIME TO MAGNESIA IN THE SOIL, AND THEIR RELATION TO NUTRITION IN CITRUS TREES.

By R. R. SNOWDEN, Soil Engineer, Los Angeles.

Magnesia is a most important element of fertility in the soil, since it is absolutely necessary to the development of all plants; and yet it may, on the other hand, become detrimental.

Kearney and Cameron, investigating the effects of various salts on plant life when used separately, found magnesium chloride more than twice as injurious as sodium carbonate, or "black alkali," and magnesium sulphate or epsom salt three times as injurious. Although calcium chloride is itself inimical to plant life, they found magnesium sulphate 196 times as injurious as this salt.

Hilgard,[1] pointing out that these results are at variance with the general experience, fittingly suggests that the discrepancies are probably due to the presence of lime in some form in all alkali soils, and its well known powers in counteracting the injurious effects of saline solutions.

Magnesium carbonate, sulphate and nitrate, are of common occurrence in the soils of the California citrus regions, and were it not for the ubiquitous lime salts, their injurious effects would be much more prevalent and pronounced than they are. Indeed, so positive is the restraining influence of lime on magnesium salts that plants are more sensitive to differentiations in their proportions than to their actual quantities in the soil, within certain limits.

Loew states that the proportion of these two constituents in the soil is a more potent factor in the resulting crop than is generally supposed.[2]

The writer believes that he has traced several cases of malnutrition, and specifically of incipient chlorosis or "mottled leaf" in orange and lemon trees, to an excessive proportion of magnesia to lime in the soil, though it is certain that some cases are due to other causes.

Taking a typical case of this disease in lemon trees, he determined the principal constituents of the ashes of the leaves from the sick and the healthy trees respectively, as well as those of the soil of the affected and the thrifty area in the same orchard. The following table gives the percentages in the ash of the leaves:

	Potash.	Lime.	Magnesia.	Phosphoric acid.	Sulphuric acid.	Chlorine.	Iron.
Healthy leaves...	8.33	39.91	3.49	0.39	3.50	.348	.216
Sick leaves	22.34	28.85	3 22	4.57	5.30	.487	.162

The potash, as shown, had increased in the sick leaves to more than two and one half times that in the healthy leaves, and the phosphoric acid to more than eleven and one half times as much, while the lime had suffered a severe decline.

The chemical constitution of these soils by no means parallels that of

[1] "Soils," E. W. Hilgard.
[2] Bulletin No. 18, Division of Veg. Phys. and Path., U. S. Dept. of Agriculture.

the corresponding leaf ash, and hence could not be responsible as a whole for the variations in the latter. Potash and phosphoric acid are practically the same in both soils, while the lime is three times as much in that soil where it is least in evidence in the leaf. The only striking difference in these soils is the fact that the proportion of magnesia to lime as well as the actual quantity of each is considerably larger in the affected than in the normal area.

This observation, in view of the untoward tendencies of magnesia, led to the suspicion that the proportion of magnesia to lime found in the affected area, namely, 1 to .49, would not be tolerated by the lemon.

That the chemical constitution of the leaves of citrus trees is not constant is shown by the difference in the analysis of the orange leaf as given by different authorities. One finds half[3] as much potash as phosphoric acid, another three and one fifth[4] times as much, while another five[5] times as much, and still another seven[6] times as much; the range of potash from the lowest to the highest compared with phosphoric acid being 1400 per cent.

One finds twice as much[3] lime as phosphoric acid, another seven and one tenth times as much,[4] and still another seven and one fifth times as much;[5] the range of lime compared with phosphoric acid being 850 per cent.

One finds two and one fifth times as much[4] lime as potash, another three and two fifths times as much,[5] and still another four times as much;[3] the range of lime compared with potash being 182 per cent.

These wide discrepancies the writer attributes to this very factor of varying proportions of magnesia to lime in the soil.

Pursuing the investigation, determinations were made of these two constituents in a number of soils where the condition of the trees was known, and the results as shown in the following table seem to justify the conclusion that just so soon as the percentage of lime in the soil becomes less than double that of magnesia there is derangement of nutrition in the orange trees, but the lemon appears to be much more tolerant of the evil. This is probably why mottled leaf is far more frequently seen in the orange than in the lemon.

The apparent exceptions to this rule found so far are easily explainable.

ORANGE TABLE.

Laboratory number.	Percentages found: Magnesia.	Lime.	Proportions: Magnesia.	Lime.	Condition of tree.
242	.07	.24	1 to 3.43		Thrifty.
240	.10	.29	1 to 2.90		Thrifty.
326	.19	.48	1 to 2.53 X-1		Somewhat mottled.
374	.13	.32	1 to 2.46		Very thrifty.
339	.28	.58	1 to 2.07		Color fine.
373	.078	.16	1 to 2.05		Thrifty.
246-7	.49	.97	1 to 1.98		Thrifty.
372	.09	.17	1 to 1.90		Somewhat mottled.
338	.21	.28	1 to 1.34		Badly mottled.
410	.39	.44	1 to 1.13		Young leaves badly mottled.
409	.41	.37	1 to 0.89		Young leaves slightly mottled.
311-3	.71	.45	1 to 0.64		Very unthrifty.

[3] California Bulletin No. 93.
[4] "The Cultivation of Citrus Fruits," Jos. Hillman.
[5] Report of the Work of the Agricultural Experimental Stations of the University of California for 1894-95.
[6] Florida Bulletin No. 138.

X-1, number 326, being far above the hypothetical "dead line" with 2.53 parts lime to one of magnesia, would seem to contradict the assumption made above; but this is a heavy clay soil and the lime is below the minimum of adequacy regardless of magnesia.

LEMON TABLE.

Laboratory number.	Percentages found: Magnesia.	Lime.	Proportions; Magnesia.	Lime.	Condition of trees.
226	.11	.38	1 to	3.41	Very thrifty.
408	.25	.37	1 to	1.51	Color good.
411	.33	.28	1 to	0.84	Color good.
296-7	.12	.08	1 to	0.67	Slightly mottled.
256-8	.49	.24	1 to	0.49	Decidedly yellow.

The line of safety appears in the lemon table to lie somewhere between 0.67 and 0.84 part of lime to one of magnesia, but in neither case is it to be sharply drawn because of the operation of other and minor factors. But there is sufficient evidence in the tables to show that the conclusions drawn are not without foundation.

It should be mentioned here that all the soil work done in connection with this investigation has reference only to the available materials, ignoring entirely, except in the case of potash, that portion of them that is insoluble in weak chlorhydric acid (1 in 5) with about one minute's boiling, excepting also that weak nitric acid is substituted for chlorhydric in the phosphoric acid determinations.

It might be profitable to consider the reasons why an excessive proportion of magnesia to lime in the soil is detrimental. The writer believes this to be in part a question of solubility.

Lime as carbonate is necessary to the trees, but the carbonate requires an acid solvent to render it available. The carbonic acid of the soil, however, is sufficient ordinarily for this purpose. But where magnesium carbonate occurs with it in sufficient quantity, the latter will lay first and superior claim on this acid, producing an alkaline solution in which the calcium carbonate is practically insoluble.

Experiments made by the writer to determine the extent of the restraining influence of magnesia on the solubility of lime salts gave the following results:

(*a*) One gram each of magnesium and calcium carbonates were shaken well with water containing much carbonic acid. Twenty-three per cent of the magnesia with a mere trace of lime went into solution.

(*b*) One gram each of magnesium carbonate and calcium sulphate were treated in the same way. Eighteen per cent of the magnesia and 7 per cent of the lime were dissolved, the latter being seven tenths the normal solubility of lime in the form of sulphate.

(*c*) A portion of soil, number 256-8, containing twice as much magnesia as lime, shaken with a sufficiency of water yielded nineteen times as much magnesia as lime to solution. The trees growing in this soil unable to assimilate sufficient lime to supply their needs, absorbed the larger amount of potash noted in the yellow leaves, to supply the deficiency of bases, the salts of potash being independent of a condition of acidity for their solution. Doubtless the potash carried along with it the increased quantities of the acids also noted.

It will be observed that magnesium carbonate rendered the lime in the form of carbonate practically insoluble while it was unable to restrict the solubility of the sulphate beyond three tenths of its normal solubility, possibly indicating the superior availability of calcium sulphate over the carbonate in the presence of large proportions of magnesium salts.

Loew has also investigated the physiological side of the relations of these two soil constituents to plant life, and reaches the positive conclusion that lime salts are the antidote for magnesium salts. In his experiments he found that lime without magnesia produced "a dense forest of root hairs"—to use his own words, while magnesia without lime produced only a few short hairs, and suggests that this explains why plants are able to absorb increased quantities of potash and ammonia salts after being manured with lime salts. It is thus seen that when a sufficiency of lime is available to the plant its feeding capacity must be much more extended than without it. It is, therefore, patent that whatever interferes with the assimilation of lime hinders the development of the feeding rootlets and must thereby disturb nutrition as too much magnesia is seen to do.

The wide prevalence of this hostile soil condition is witnessed by the fact that in thirty-two soils examined, from the vicinities of Santa Ana, Tustin, Rivera, Whittier, El Monte, Covina, Charter Oak, San Dimas, Pomona, Ontario, Pedley, Corona, Imperial Valley, Hinkley, Glendale, and Los Angeles, only thirteen met the requirements of the orange with regard to proportion of lime to magnesia, while nineteen fell under the ban of the supremacy of magnesia.

Since lime is depleted by the processes of nutrition more rapidly than is magnesia, it is not surprising that many citrus trees after flourishing for a time ultimately show the effects of the relative exhaustion of lime, notwithstanding that its actual quantity in the soil might still be above the ordinary minimum of adequacy; hence it must be more than a coincidence that while the writer has often wondered that this well recognized subordination of lime to magnesia is so generally ignored, the citrus orchardists also have been wondering why their trees are so often mottled and sometimes unprofitable.

Who can tell how much of the failure to set fruit, dropping of fruit, deficiency in quality of fruit, and other manifestations of weakness on the part of the tree is directly or indirectly due to this condition, since, as it is well known, a weakening of the organism, whether vegetable or animal, renders it more susceptive to the attacks of all its enemies of whatever kind. Certain it is that the oranges most famous for their fine quality are grown on land that is very rich in available lime. As widely as we have seen the analysis of the orange leaf to vary, the fruit is subject to like variations in the proportions of its constituents. The University of California found the lime in the fruit to be equal to 26.5 pounds in a car load, while Hillman found the average of a large number of widely divergent analyses to be 115 pounds. It is surely by no accident that this is so. Certainly then some peculiarity of soil condition predetermines this, and the writer attributes this also to the relations of lime and magnesia or some analogous condition, without the proof, however, at the present time.

MODIFYING CONDITIONS.

Magnesium salts being more soluble, are also more mobile in the soil than calcium salts; hence the capillary efficiency of a soil may exercise a direct influence over their mutual relations. The relations of magnesia and lime may be modified by judicious use of irrigation water, and by efficient use of the mulch.

The proper balance of the two may be maintained by adequate additions of lime in a suitable form, the sulphate being apparently the best.

CONCLUSIONS.

(1) Many citrus orchards are probably close to the limit of tolerance, but are maintained in a state of moderate thrift by the generous applications of superphosphates they are receiving, owing to the large percentage of calcium sulphate they contain whether made from rock phosphates or bone. So many cases of mottled leaf have been cured by the use of superphosphates that this trouble has come to be attributed to a lack of phosphoric acid, when in fact it is doubtless due to a lack of lime and probably the sulphate. This mistake is most natural, since the trouble might be manifested in the presence of what would be a sufficiency of lime when its relation to magnesia is neglected. (2) The water supply as well as the fertilizer materials should be rigorously censored against the undue introduction of magnesia into the orchard soil.

[Applause.]

MR. MASKEW. In relation to the paper just read I have been requested to make this announcement:

Should this work prove of any value to the citrus orchardists, the credit should be given Mr. W. S. Sparr, since he not only suggested that the work be undertaken, but also made it possible for me to undertake it.

R. R. SNOWDEN.

PRESIDENT JEFFREY. Is the convention ready to hear the report of the Committee on Resolutions?

MR. CALL. We wish the secretary of the committee to read the report, and then, if it please the convention, I would like to add a few remarks.

MR. SMITH. Before reading these resolutions, I want to say, on behalf of the committee, that, as you will remember, your chairman suggested that any resolutions that might be offered by any member of this convention should be submitted to the committee. A number of suggestions on matters of value to the citrus fruit industry have been handed in, too many to be made part of these resolutions. These resolutions, as you will see, provide for a committee of seven. Those suggestions of value are all filed and will be handed to that committee when appointed and ready to serve, and they will take cognizance of those and act upon them. We thank each member of this convention who has shown his interest in the matters before the convention by presenting those suggestions. Our committee desired to make the resolutions short and to the point. They are as follows:

To the Members of the Thirty-seventh State Convention of Fruit Growers:

GENTLEMEN: Your Committee on Resolutions do hereby offer the following resolutions for your consideration:

1. *Resolved*, That it is the sense of this meeting that the facts as presented and discussed at the sessions of the convention in relation to the decadence of the older citrus fruit orchards, as substantiated by the available statistics, fully justify the State Commissioner of Horticulture in calling this convention; it is further

2. *Resolved,* That in view of the facts brought out in discussions, relating to deterioration in older citrus fruit orchards, which we believe can be remedied by scientific research, and emphasized in many communications to the State Commissioner, and realizing the magnitude and far-reaching consequences for ill to the citrus fruit industry, if these matters fail to receive the needed attention; and bearing in mind the great and beneficial results that have come to the citrus fruit industry of this State through the investigations of G. Harold Powell and R. S. Woglum, as instituted by the United States Department of Agriculture, it is the sense of this convention that an appeal be made to the United States Department of Agriculture for a special investigation into the causes of decadence in older citrus fruit orchards, and that we also invite the attention of the State Agricultural College to this subject.

3. To further promote the wishes of this convention, it is resolved that a Committee of Seven be appointed by the Chair to present the facts to the proper authorities, and to secure from the Congress of the United States the necessary appropriations for carrying on the work of such investigation, and to take such further action as may appear desirable in the premises, such committee to be approved by a committee of three appointed by this convention.

4. *Resolved,* That we commend the work of the Pathological Institute at Whittier, and that of the Experiment Station at Riverside, but we deplore exceedingly that at a time when his services were desired, a six months' leave of absence should be given to the Superintendent of the Pathological Institute at Whittier to attend to other and private interests.

5. *Resolved,* That we commend the helpful interest and work of Pomona College in all matters pertaining to the interests of citrus fruit growers.

Your committee also suggests that the convention tender a vote of thanks to the local committees for their efficient services in preparing for the convention, and to the people of Pomona for all courtesies extended to visiting delegates.

The committee also recommends that a vote of thanks be extended to all who have prepared papers and taken part in the discussion, and heartily commends the chairman for the manner in which he has conducted this convention.

Respectfully submitted,

N. W. BLANCHARD, Santa Paula.
A. F. CALL, Corona.
FRED J. SMITH, Pomona.
THOMAS STONE, Pasadena.
DR. J. ALLEN OSMUN, Whittier.
B. B. WRIGHT, Riverside.
ROY K. BISHOP, Orange.
J. L. HARDEMAN, Porterville.

MR. CALL. Mr. Chairman, I desire to move the adoption of the report, and in connection with it I would like to make a few suggestions.

The motion of Mr. Call was duly seconded.

MR. CALL. *Ladies and Gentlemen:* These resolutions are of far reaching importance to the citrus industry and deserve careful consideration. I realize that we have a great divergence of views on some of these questions. I noticed that more particularly last winter in going around over southern California with Mr. Chase, Mr. Woodford, Mr. Hampton and others, in gathering statistics for the Interstate Commerce Commission with regard to this industry. We found that in some localities there appeared to be no decadence in any kind of citrus fruits, although we found old orchards. We did not find what we regarded as decadence in any lemon growth nor in any seedling orange growth nor in any grove of bloods, and I guess I might say of sweets, but we found in some localities a very marked decadence in quite a large percentage of the older navel orchards. When we got all through, after spending five or six weeks at the work, making careful investigation as to acreage, having a committee in every locality estimate the acreage and give it to us by numbers and names so we could verify it and compare with the assessors' returns of trees in bearing, we found this to be the fact, that in the last six or seven years we had doubled the acreage of bearing citrus groves without materially increasing the output, and which had resulted in a very large increase in the expense of

production per tree. At Corona, where I live, we had 2,500 acres of orange trees from fourteen to eighteen years old and our production was on an average of one car to five acres, or less than 100 boxes to the acre. Our highest was one car to four acres. Riverside was 10 or 20 boxes better, and Redlands a little better, and Highlands had the highest output, of about 140 cars. We came around this way and looked over every colony; we found the old orchards were not bearing as they should. It will be said that that is due to want of care, and this committee has no quarrel with that decision. We do not antagonize a single view that has been presented, because we simply take the position that we don't know. All we say is that this is a condition that is worthy of investigation, and citrus growers should not be afraid of the truth. Now, the truth may hit in different ways. When the assessor comes around to assess your groves, you are not boasting particularly about the production of that grove. When the Interstate Commerce Commission comes around and says, "We are going to fix these rates somewhat upon the productivity of this property and inquire whether the investment pays," you are not particularly anxious to put the fancy groves to the front. You are willing to take the average truth. And when congress inquires into this matter as to the tariff, you are anxious about the matter of protection. But when you have got a grove that is a little decadent, and you want to find a fellow to buy it, you don't want a resolution to go out that some of the orchards are not producing as well as before. But the absolute truth, I think, of this matter will strike an average of our condition and give every man all that he is entitled to have. I hold that a man who puts off a poor orange grove on to a tenderfoot is doing a worse thing than if he held a pistol to his head and took his money, because then he is simply taking what money he has on his person, while in the other case he takes the earnings of a lifetime. [Applause.] These resolutions are not aimed at any industry. We don't say your tree is beyond recovery. We believe this industry is on the uplift; we believe we are going to conquer all our troubles, but we want the government help to do it, and that is all we say by these resolutions. [Applause].

The motion to adopt the report of the Committee on Resolutions was carried.

Mr. C. C. Teague, Mr. P. J. Dreher, and Mr. A. F. Call were duly nominated and selected as the Committee of Three, referred to in the resolutions.

On motion of Mr. Paine, duly seconded and carried, any or all of the members of the Committee of Three, whom the chairman might wish to appoint as a member or members of the Committee of Seven, provided for in the resolutions, were authorized to resign from said Committee of Three.

PRESIDENT JEFFREY. Now we will have an address—"Cultivation, its Relation to Plant Disease"—by Mr. Macoun, Assistant Superintendent of the Arlington Heights Fruit Company. [Applause.]

CULTIVATION, ITS RELATION TO PLANT DISEASE.

By D. B. MACOUN, Riverside.

MR. MACOUN. *Mr. Jeffrey, Ladies and Gentlemen, and Gentlemen of Pomona*: I think there is something due to you to-day, perhaps, more than to other districts of California. It is said to-day that you have magnificent orchards and also that you have a bounteous crop. From other districts we have not had those reports, and I must say that you must be doing your business better than any other districts, especially in Riverside, where our Commissioner did say that our crops had not come up to the crops of years ago. The question comes up, What is the reason? In your resolutions I don't think you cover it. If you state that malpractice, malnutrition, was the cause of decadence, I believe you would hit the nail on the head. I don't believe for an instant that the age of a navel tree is fifteen years; I don't believe it is twenty years, nor yet do I believe it is thirty or thirty-five. In starting out in life with considerable money, virgin soil, an orchard well looked after, and at the age of twenty it is an old orchard, is it not a terrible thing to think of? I have thought of raising an orchard for myself and family, and, very likely, those who are to follow them. To-day I leave the convention with the opinion that fifteen to twenty years is the life of a navel tree! I say emphatically I don't believe it.

When I heard what was said here to-day it put me in mind of a story about a friend of my own; he was a journalist, an Irishman from the west coast of Ireland. He was sick and they thought he would not get better. They asked, "Were the people you sprang from of a vigorous race? Were they long lived?" He looked at them and said, "Doctor, it all depended on the government in power." His forefathers had been hung for treason.

The life of the navel tree depends on the man in power; it is the man who has control of that orange orchard. We are dealing in orange land; it is a case of barter and sale. We plant a tree which should never be planted; we plant a tree without knowing the class of soil. Who among you has, even in your old orchards, dug down six or seven feet to test the soil? How many here to-day, if asked that question, could raise their hand? How many here to-day after they have dug down have had that soil analyzed to find the minus quantity? Is there a man here to-day that has done that, with all the thousands and millions involved in California?

As I said before, it is not the decadence of the orange tree; it is the decadence of the man who is running and governing and controlling the interest of that tree. [Applause.]

I am a great believer in Professor King, a man whom you will have among you here in California. I believe there is no peer of King and Hopkins in the United States. King says: "The soil is not a grave where death and silence reign, but rather is a place where the cycles of life begin anew to run their course, over and over again." Take it ten years ago, before we had a fertilizer law. What were our orchards then? A dumping ground. Was it not a dumping ground for all the fertilizer that any fertilizer man could sell you? We knew nothing about nitrogen, phosphoric acid, lime and humus. To-day we know more. We know, by the investigations of the pathologists, that

fertilizer men are good men to-day because our laws are beneficial to the farmer. Business is business to-day, and the fertilizer man will chew the meat of an orange tree and tell you it needs phosphorus, and perhaps we buy it. He will never tell you that it is the physical condition of the soil that is wrong, and here are a few things that I believe in. Soils are never exhausted of their potential plant food. Worn-out soils are not exhausted chemically but physically. Their humus has been used up. Soils once productive but now unproductive may be restored to their former state. That is as true as it was a hundred years ago. You take France in the sixteenth and seventeenth centuries and what do you find? That with a population a great deal less than they have to-day they were unable to grow crops to feed the people they had then. With improved methods of cultivation, what have they got? They have a population equal to that of Belgium. Take England—33 bushels to the acre; Germany, 28 bushels to the acre; United States, with virgin soil, 14 and 15 bushels to the acre. What is the reason for this? You must look at the place where the tree is planted, and that is the soil. You follow this thing through the centuries that have gone by and nearly every people have worn-out their virgin soil and just come to the place where we are to-day. In the Genesee Valley in its old days, Illinois, the Dakotas, Manitoba and the Northwest Territory. What do you find? The virgin soil producing crops for a number of years, farmers taking up all they can get, and what have they got to-day? Just the same results; you have farmed a virgin soil. You say I should put in fertilizer; you have, but you did not put in the right kind of fertilizer. From the day it was planted out you should have been growing cover crops. Take, for instance, the working of a ten-acre orchard as it is worked in California. I don't say my orchard is good; I say it ought to be better. I can prune off my own mistakes. For every one of those things we are talking about I believe in pruning. Take a tree ten years old, lopping off branches that cost money to grow. Is there not something wrong? Some of those branches are dead at the end. I am not talking of that lateral wood that was suffocated for the want of light; I am talking of branches on the tree that took money to grow, and here we prune them back. The old saying is the doctor buries his mistakes in the ground, but ours are standing before us every day in the orange orchard. Then a man comes along and we prune them back to cover up our mistakes. For instance, I plant an orchard here. Take Riverside soil; I am better acquainted with that than I am with any other. The first years, under the old way of handling an orchard, it was fallow, it was open cultivation, and years rolled on and it was open cultivation, and on every ten acres I had two inches, which gave me for six weeks' cultivation ninety inches of water. It took that ninety inches of water to irrigate the ten acres. When that orchard came to be fifteen years old I had more water than I could use. And the trees needed double the amount of water. Now, what is the reason? From the very methods of our cultivation and in growing cover crops, we have made a soil hard, intense, unable to be ventilated or aerated. If you don't get good air introduced to your trees you will have all the troubles Mr. Ballard and the others have been talking of. I believe those all come from soils that are not well aerated, not well ventilated and not well drained—every one of them, and more especially aeration and ventilation. Take California here to-day. You have a

family doctor. The first thing he tells you is to have a screened porch to sleep on. Why? It is simply for better air. Did you ever think that the environment of a tree had to be just as comfortable as your own? Is it not possible that that very oxygen, so necessary for ourselves, should come down through the ground and be there at its roots and around its roots every day and night of the year? Plowing under all kinds of fertilizers and examining the ground on top, show that neither gases can get out nor air get in.

I believe trees are almost immune from some diseases. Take gum disease. We find that we can cure gum disease by cultivation, doing good work in that part of the orchard where we can work a four-horse cultivator, hoeing under the trees, then digging around those old trees and exposing the crown. We can cure gum disease just by that method alone. In talking last summer with a pathologist here, I asked him this question regarding wither tip. If I have an orchard afflicted with wither tip, and everything is suitable, what will bring it on? Will lack of cultivation bring it on, lack of proper ventilation and aeration? Will the weakening of the tree under those conditions bring it on? He said it would. I know full well that to irrigate a tree that is drying, the leaves drooping, it droops in dry soil—to turn water on it the conditions are going to be bad afterward. Mr. Galloway, Chief of the Department at Washington, says it will start conditions in that tree that will know no ending. Some days the roots of our trees are dry and some days they have more moisture than is necessary, and still we follow the methods followed ten years ago. The trouble with us to-day is that we are not living up to the best we know. There is not a report from any of those experimental stations to-day but will teach us how to better the health of the tree. Just an instance, some of the work we do. I call it marking out. I mark out a piece of land for irrigation and I mark out the mulch; it may be five or six inches deep. I have then ninety inches of water and I run on that. I mark the mulch out and the hardpan formed underneath, how many days will it take to penetrate? It will take a day and a half, and the mistake is that by not breaking up that hardpan you have lost the success of an irrigation; no water has gone down to the depth. I will tell you a case in point. Five weeks ago I irrigated ten acres of lemon orchard. The mulch was marked out. Three weeks afterwards I marked it out by putting a weight on the bottom of the marker. I put on 170 inches. Would you see any difference in the growth of those trees? You would. A man would say it was well looked after. And that thing follows all through the summer work.

Regarding the depth of cultivation, every man should know his own land to the extent that he should know how deep he should cultivate. Cultivation in the summer months means conservation of moisture. If it is deep enough to conserve moisture it is deep enough to air the roots. It is impossible to say, "I cultivate three inches, four inches and five inches" and put it as a standard. Every man must know his own soil. Some soils to-day on Arlington Heights we cultivate three inches. Years ago we cultivated six. The result was mottled leaf. For the last twelve months we have cultivated three inches deep. We have changed it from a mottled leaf to a good dark leaf. Why? Simply because we did not turn the humus out. We paid fertilizer men considerable money in leading fertilizer to those sandy orchards and then we culti-

vated six inches. What was the result? Mottled leaf and weakened tree. The want of humus means starvation to a tree or grain or anything you may wish to grow. The depth of cultivation on the granite soils that we have there just simply means this, that I have to cultivate a depth sufficient so that on six weeks' irrigation it will absorb ninety inches of water. No man can tell another how deep he should cultivate. It is a strange thing to me; I can't see how he can. The very condition of the soil, what the soil is derived from, is a controlling factor in the depth I would cultivate. The arrangement of the soil and capillary attraction have a great influence on the depth I shall work the soil, both in the summer and the winter.

Another thing about renovating the soil, making it a fit place to grow a navel tree that will live longer than fifteen years. If I thought a navel tree would only grow fifteen years I would go out of business to-morrow. Our method of handling stable fertilizer is, we plow it under in the winter months with a disc plow. How much of that soil is affected by that fertilizer? I mean, how much soil is physically changed? Not one inch below the depth of that plow. You can pile on all the manure that it is possible for an orchard to take and the physical effect will be the depth of that plowed soil. From year to year, without the growth of cover crops, that has been getting harder, more intense, less liable to take water or throw off gas. Aeration and all those things that affect trees are not thus improved by the growing of cover crops. We will have a chance, with the roots of those cover crops, to penetrate that hardpan and make it a fit place for trees to live. I believe the trouble with two thirds of our trees is that their roots are suffocated. I believe that they are getting neither air nor water only through the medium of holes put there by cover crops. We sow our cover crops. We are irrigating and cultivating with a four-horse team, six inches, seven inches. That irrigation hardpan forms; it may be four inches, it may be three inches. What have we done to break that up? If I was growing grain I would not sow on a place like that. I would go in there and tear up that irrigation hardpan. Give the tender roots that the vetch will send out a chance to penetrate to the depths. You expect the tiny roots of the vetch or the peas to break up that hardpan. Is that wise? Shouldn't we break that and know that the roots can penetrate to greater depths?

Another thing I want to speak of, the drilling in of fertilizer. What does King say? King says that fertilizer put in shallow in this country—of course, it is irrigated and dissolved—where do you find the greatest amount of that as returned in the soil moisture by evaporation? By capillary attraction. You will find the greatest amount right underneath your mulch and out of the zone of the trees, to the extent of what King says of 200 or 300 pounds per acre. It is a considerable quantity to have above your root zone. It is a considerable quantity to have where your roots will come up where eventually they are going to be affected by the heat of summer and the warm winds. Don't you think deep cultivation has something to do with keeping a normal condition under that mulch? One hundred and eight under a good mulch affects the tree very little. I have taken the temperature and there is all the difference you could imagine between a hot day and a cold day.

Now, those are some of the things to-day that I believe have brought about the decadence of our orange groves. I don't believe that all trees

are going to be long lived, because all trees are not put on the kind of soil they should be. We have dug down in our soil six feet; we have taken samples, we have had them examined for magnesia, potash and lime; and on the Heights you will find the difference as wide as the poles, as far as the compactness of the soil goes, as far as the soil is able to retain moisture, and those things that go to control the general health of a tree. I believe in pruning just as thoroughly as Professor Paine, but I think we start too young. At the time he was pruning his trees there should have been vigorous tops. I believe that by proper methods of handling our orchards, winter and summer, by keeping an even temperature, by proper cultivation, never allowing the roots to get dry, always a proper amount of moisture, a tree will grow into normal condition and you won't have to bother your head about where the seeds came from or where the buds came from or who grew the nursery stock. As regards the old trees, that is beyond our reach. I believe in plant selection. I had something to do with the selection and handling of plants on an experimental farm in Canada; I had it nine years. We were able in ten years to raise the latitude of growing wheat as far north of Ottawa as New Orleans is south of Ottawa. We are growing wheat in the Arctic Circle. The vital question with us to-day is the orchards that are fifteen, twenty-five, thirty-five, and forty years old. I saw the oldest orchard to-day in Riverside county; it belongs to Mr. Burney. I saw some of the trees just as good as they were fifteen years ago; I saw others that were dead or dying. To-day I came by one of the first trees planted at Riverside. That tree is just as healthy and strong as it was twenty years ago, in better shape, in better condition, I believe, for at the present time it has proper cultivation and proper nutrition. [Applause.]

MR. CALL. I want to say that the Committee on Resolutions left one resolution until the last, and that is a resolution that I now offer and move the adoption of, that this convention tender its most hearty thanks to our President, our able Horticultural Commissioner, for his efforts in our behalf and for bringing this convention at this time and giving us the benefit of his views and information and all the help he is continually giving to southern California.

The motion of Mr. Call was duly seconded, and the resolution unanimously adopted by the convention rising.

MR. GRIFFITH. I would like to ask Mr. Macoun a question. I have listened to-day and yesterday to some valuable papers. It is evident to me from what he and others have said that we are forming more or less hardpan under all our soil; that is, that our soil is becoming compact under the plow share. If I plow with a deep plow, or if I subsoil, will I not tear up the feeder roots between the trees, and if I do, shall I fertilize that same soil with the feeder roots all cut out?

MR. MACOUN. I might say to the gentleman who asked that question that what I meant to say and what I would say now is this, that in plowing an orchard, the question is, how are you going to plow, how disturb that soil? There is no implement made that you dare use. The only means that we know of to-day is by cover crop. We have, by bad farming, got a condition in our orchards, a condition under that part that we have been plowing and cultivating and killing, that we dare not use the implements we have, and the question is simply this: How am I going to disturb that soil that is formed right underneath

the plow sole? To me that is the most vital question in the orchard to-day, that part underneath the plow sole down to the tree zone. It is a depth of ten to twenty-two inches. I can disturb the soil, I can keep it in good physical condition for eight or ten inches on top, by cultivation, by plowing, by stable fertilization, by straw, by any decaying vegetable matter, but how are you going to keep in condition the soil below? Only by cover crop. I look upon the cover crop as the salvation of the orange orchards of California. For every one of those roots is moving more or less particles that had become solid, particles that had become cemented together, and as those roots decay they allow water to percolate to the lower depths. Take some of our old orchards to-day when we plow them and the particles do not break. What is the reason? Bad physical condition. And I believe this, a good physical condition—I don't say it is a panacea for all your ills—aye, not by any means, but followed year after year it will give us a healthy tree, it will give us water underneath where water has never been able to go through. If we only can, through some ingenuity, find something that will disturb that soil right in the root zone.

MR. GRIFFITH. What kind of cover crop?

MR. MACOUN. We are using vetch to-day; we have used Canadian peas.

A MEMBER. How deep do the roots go?

MR. MACOUN. I have measured roots of vetches twenty-five inches. There was an experiment carried on by Doctor Porter; some three or four years ago they carried on experiments in Arlington Heights. He gave me the vetch to plant; I planted them. He measured the depth of soil; the roots were thirty-five inches. Those roots had no obstacles against them; they had good loose soil. I have measured the roots that we have grown on some of our own land—ten inches, fifteen inches. I sowed those vetches I am telling you about on hardpan. The roots struck the hardpan and moved on away horizontally. Some of them penetrated through, others did not. The proper handling by a grain farmer, when he would find a formation underneath the surface soil, would be to put a plow on and plow it up. If he got that soil in good condition he would then sow his grain. He would have an idea that the roots then would have a chance to go down and be well fed on going down. The orange farmer sows right on that hardpan and expects the roots to go through and give him a great crop. If we, in the fall, in August or September, plow deep enough to break that hardpan and turn around and sow our vegetable upon it, we have done good farming. You have then a soil that is mellow and you will have a chance for a crop, and without it I don't see how you can.

MR. PAINE. Would you have us here in August and September, before we sow our vetch, do a heavy plowing; and whether it is destructive to roots to do so?

MR. MACOUN. The only plowing I ever do in August or September is for breaking up a hardpan; I would plow just so deep and not any deeper than would break up that hardpan. Some of you may say it will destroy the growth of the trees. I plowed 150 acres of lemons last year for no other reason than to break up the hardpan that I might get water to the lower depths, and that those lemons might grow and come into the market when we might get something for them. It is easy to grow lemons so you can pick them in the winter time; it is much harder to

grow them and pick them in October. I thought by plowing I would increase the growth of that tree, and I believe we did; I believe that we made money last year in plowing our lemons in September and breaking up that hardpan and getting the water down good and deep.

PROFESSOR COOK. I was a little in doubt as to what Mr. Macoun meant by pruning. How early would you commence pruning lemons and oranges?

MR. MACOUN. I take the suckers out of young trees at all times after they are planted. The regular pruning starts with us about four years old.

A MEMBER. Suppose your hardpan went down eight inches, how would you get to it?

MR. MACOUN. I would go as deep as necessary.

A MEMBER. Some of it is ten or twelve inches deep.

MR. MACOUN. That is a different kind of a plow sole from what I am talking about. It forms between every irrigation. There is no cultivation that you do in the summer time but what that forms from the depth of two or three inches. It is impossible to irrigate and not have that form. That irrigation hardpan I am speaking of. I am not speaking of that irrigation hardpan down twelve or fifteen inches.

MR. KOETHEN. Do you plow the same depth that you cultivate, as a regular practice?

MR. MACOUN. Are you asking me in winter plowing?

MR. KOETHEN. Yes.

MR. MACOUN. I plow deeper.

MR. KOETHEN. Why?

MR. MACOUN. I want to cover up, in the first place the cover crop that I have already grown, to a sufficient depth that its decay will be rapid; and, secondly, I do that to get a depth that will give me a good working mulch for the coming summer. The man that does not get his orange grove or lemon grove in good physical condition before the month of May or June is up against it all the year. You can hear the teeth of his cultivator rattling over those dry bones all summer.

A MEMBER. I would like to ask Mr. Macoun what is the effect of getting so much extra water into his soil in September. Does it not result in giving you too large a percentage of moisture?

MR. MACOUN. We were getting no water at all in. The irrigation hardpan had formed so hard underneath that the water would not penetrate in a three days' run. I plowed deep enough to plow that up, marked it out again and put 170 inches of water in it. This year we got sixty and seventy inches.

A MEMBER. The question I wanted answered was, does this application of so much water to an orange tree in September result in large sizes? Many horticulturists tell us that we should withhold the water at that time. We can not do it and raise a cover crop.

MR. MACOUN. I will say nothing about that. The reason we did this work, the reason I want to break up the hardpan, is for the roots of vetches to go down in the soil where the Lord intended they should go. It is to break up that hardpan, so the roots of trees and vetches may go down and make passages for water to go down.

A MEMBER. I would like to ask Mr. Macoun if he has ever tried sowing grain with his vetch. We are doing it this year.

MR. MACOUN. We have not done it with the idea of mixing vetch and grain, but we bought the seed and found it was mixed with barley and vetch. We did not buy it with the idea of sowing mixed grain. We got good results from it. Johnson, in his book on How Plants Grow, says that he has found the roots of wheat seven feet in the ground, but he tells you the condition. The condition is a good, friable soil.

A MEMBER. At what time do you plow under your vetch or your cover crop?

MR. MACOUN. The time to plow it under all depends on the party in power. If we haven't too much work to do we plow it in and get it finished up by the middle of March, sometimes the end of February.

A MEMBER. That depends upon its maturity.

MR. MACOUN. Not so much on its maturity as the force we have on hand to handle it. I will say this: if I was plowing under cover crop of my own and had all the help available, I would like it plowed under some time about the latter end of February. I will say this in passing, that the man who allows the moisture from the strata below to escape before the months of April and May can never turn to irrigation water.

PRESIDENT JEFFREY. We will have to close the discussion now, interesting as it is. Mr. Cumberland, of your city, asked me to give him the opportunity to ask two questions and I promised to do that. Mr. Cumberland will ask those two questions now.

MR. CUMBERLAND. What is the cause of that which is known as Florida die-back and what its remedy?

MR. CALL. They tell me in Florida it is due to organic nitrogen, and use a little more mineral.

MR. JONES. May I make one suggestion? In connection with the fumigation business, we are paying out an enormous amount of extra money. It is costing the orange growers a great deal more than there is any necessity of doing. A considerable percentage of that cost could be saved by the handling of the business by a businesslike organization, formed, perhaps, through the California Fruit Growers' Exchange or some other great interest in connection with our industry.

PRESIDENT JEFFREY. Would it help you any to read a paper in the report which will be issued as soon as the State Printer can get it out?

MR. JONES. I think it would be an excellent idea.

PRESIDENT JEFFREY. We are going to have it; it is provided for. The Los Angeles County Commission, when called upon yesterday morning for their report, were not ready. Mr. Meserve's report will now be read.

Mr. Chairman, Ladies and Gentlemen of the Convention: In presenting this paper for your consideration, I have eliminated every possible word and term down to such an epitomized condition of abridgment that only the pith of the lengthy reports given to me by the inspectors detailed for the investigations are embodied herein. This has been done to avoid taking very much of your valuable time, and also to comply with a request of the State Commissioner that I abbreviate brevity.

The subject is the cause of the often asserted deterioration in fruit producing of the Washington navel orange tree, after attaining the age of sixteen and more years from time of planting in the orchard.

The instructions given to the inspectors included soil conditions, fertilization, fumigation, cultivation, irrigation, pruning, and general management of the orchard, whether regular and persistent or neglected and spasmodic.

The practical value of an article of this kind mainly depends upon the qualifications of the men assigned to the duty above outlined, and the manner in which they may have performed that duty. In further explanation, I will state, these men for ability to observe, judgment in comparison, capability to formulate and make final deductions,—an acquirement that can be attained only for best results by daily and lengthy experience in orchard inspection,—can not be surpassed by any like body of men in similar pursuits in this State.

I will commence at the east end of this county and go west,—without any of the disparaging insinuations we are so familiar with,—because it is far from being applicable in this instance.

Mr. C. H. Vary, the horticultural inspector in the Pomona section, has systematically carried out every side of the prescribed research, and the conclusion by him is no deterioration in any orchard that has received proper attention, notably, three orchards from eighteen to twenty-one years of age, owned from planting to the present time and under personal supervision by the same individual.

Many of the other orchards have changed ownership repeatedly, and naturally have received treatment according to the ability, length of time in possession, and character of owner. All in all, trees are very satisfactory.

Mr. H. S. Walker, of San Dimas, in a rather crestfallen manner, intimated that he could not furnish any material of value, for the reason that their orchards do not and have not shown any deterioration. In proof, he submitted as a sample of continued profitable yielding of fruit, the results from two orchards that are no exception to the rule, each twenty-two years old.

FIRST ORCHARD.		SECOND ORCHARD.	
1901 to 1902	3219 boxes	1901 to 1902	2096 boxes
1903 to 1904	4220 boxes	1903 to 1904	6488 boxes
1905 to 1906	4124 boxes	1905 to 1906	4400 boxes
1908 to 1909	4209 boxes	1908 to 1909	4899 boxes
1909 to 1910	6650 boxes	1909 to 1910	6621 boxes

Another orchard, nineteen years old, from 1903 with 4,534 boxes to 1910 with 4,770 boxes. The years missed gave the same average returns in the three orchards noted.

Mr. J. R. Hodges, of Covina, had the most difficult task allotted to him of any of our force, because of the extensive field to cover and the varied conditions existing in his district.

Until about two years ago, this section contained as many acres devoted to citrus culture as any county in the State, excepting one,—so asserted by competent authority. This has been somewhat curtailed by the creation of new districts and the adjustment necessary. The conditions existing with him show first-class culture to almost absolute neglect. His report covers over six typewritten pages, which are condensed into these few lines. This action has destroyed valuable details.

In summing up the fertilizer side, he says: Plenty of fertilizer, plenty of fruit; some fertilizer, some fruit; no fertilizer, no fruit. The results from four orchards, planted twenty-four years ago, from the

same stock and the same nursery, are mentioned more particularly from the fact that he has been personally cognizant of the conditions existing in such during all this time. Three have received the best of care and been remunerative from start to date, producing slightly over four hundred packed boxes of fruit to the acre annually, since arriving at full bearing capacity, with even a better showing for the coming season. The fourth orchard was sold about nineteen years ago to a man who evidently did his best to learn how much neglect of essentials in the care of trees could be given and yet retain vitality enough to produce one half box to the tree. About four years ago the present owner purchased this orchard, and to-day the indications are that the yield will be equal to the other three.

Mr. S. L. Spencer, of Irwindale, summarizes the situation in his district in the same manner as Mr. Hodges, hence it would be only a recapitulation to say more. He mainly confined himself to the evident causes of deterioration and best methods for rehabilitation.

Mr. W. E. Dougherty, of Azusa, whose knowledge of the extensive groves in that section embraces a number of years, writes that he does not know of one orchard that shows the least indication of non-productiveness where the owners have given proper treatment.

The findings of the above men are indorsed by every member of our force.

In conclusion, let me say that I believe from the extensive data in my possession, the prevailing idea with many of navel orange deterioration is a purely chimerical notion without any evidence of fact, except when caused by neglect in some form. Every failure is a violation of one or more of the fundamental principles of latter day culture, and any person who may contemplate establishing an orange orchard as a business proposition need not fear if the enterprise is founded upon the concrete base of water, soil, and climate. Success also depends upon strict compliance with the five tenets of horticultural faith—irrigation, cultivation, pruning, fertilization, and fumigation. These strictly obeyed, there is no doubt of the salvation of the navel orange for the present and a long distance into the future.

PRESIDENT JEFFREY. I have just received a telegram from Prof. Wm. T. Horne of the University, stating that his train has been delayed, but that he hopes to arrive before the close of the convention.

MR. GLASCOCK. I think it only proper that we express to Professor Horne our regret that we can not wait to hear his paper. I make a motion to that effect.

The motion was duly seconded and carried.

MR. A. F. CALL. I move that this convention express by rising vote its appreciation of the manner in which this conference has been conducted by the State Commissioner of Horticulture.

After this vote had been taken the convention was again seated, and upon motion, duly seconded, the convention adjourned.

(As Professor Horne's and J. P. Engelhardt's addresses relate to a subject within the call of the convention, and both expected their papers to be read before the convention, they are here inserted within the body of the report.)

ROOT ROT OF CITRUS TREES.

By Wm. Titus Horne, University of California.

Under the name root rot of citrus trees I propose to discuss a specific disease from which citrus trees suffer in California. As a means of giving a clearer idea of its characteristics I shall refer briefly to some other citrus troubles in which the roots rot.

The roots of any tree may be killed by poisoning with various substances, such as illuminating gas escaping into the soil, excess of alkali, etc. Decay of the roots follows, but usually there will be nothing characteristic about it. Professor Hilgard* pointed out some time ago that an excess of lime in the soil might kill citrus trees, but the behavior of the roots is not described. I have seen during the past winter trees in bad condition, which, on examination, proved to have their lower roots rotted off. The soil a little below the surface was saturated with water, and apparently the death of the roots was a direct effect of the saturation. The condition of the soil has been improved and nearly all of the trees are promising to recover nicely.

Foot rot is probably the most widely distributed and destructive of all citrus troubles. In this disease decayed areas appear on the roots or the base of the trunk. The decay is of a peculiarly violent type, the roots affected being killed, and accumulations of gummy or nearly liquid material with an offensive odor being found below the bark. Fungous threads are often seen on decayed roots of this kind, but they are cobwebby and can not be seen to penetrate the decayed bark on examination without a microscope. In spite of the fact that foot rot is so old and serious a disease, no satisfactory study has been made of it. Professors Smith and Butler† have distinguished foot rot from gum disease, and given an excellent treatise on the latter. However, the same conditions bring about the two diseases and the same measures should be used in treating them. Incorrect water supply in the soil is the cause. Generally the trouble is a water-soaked subsoil. I do not know whether the bad effect is due to too much water or too little oxygen, or to some harmful development of soil bacteria. At any rate, it seems to be generally admitted that the most important remedial measures are to give a proper moisture content to the soil and good aeration. One of the first steps is to get the crown of the tree well exposed to the air.

I have seen in Cuba a type of root rot affecting the top as well as the roots. The whole tree or only a small part may show the trouble. During the hot weather of early summer one or two trees in fifty or a hundred acres would wilt suddenly and the leaves dry on the tree. The affected bark on trunk, limbs and root would be sour, and on the root would peel off in long, soft strips. The wood below the affected bark would be lightly stained to some depth. The part of the tree not affected would continue to grow thriftily.

The troubles I have just described are in one sense root rots—the roots rot—but they are not the root rot of which I wish to speak more particularly. They result directly or indirectly from the surrounding

* Hilgard, E. W. Marly subsoil and the chlorosis or yellowing of citrus trees. Circular No. 27, Univ. of Cal. Exp. Sta., 1909.

† Smith, R. E., and Butler, O. Gum disease of citrus trees in California. Bul. No. 200, Univ. of Cal. Exp. Sta., 1908.

conditions. They are obscure, difficult to recognize, and mostly not well understood. The true root rot, however, is due to a definite parasitic fungus,* and when once known it is easy to recognize.

True root rot, known also as the toadstool disease or oak fungus disease, occurs on citrus trees in California and perhaps also on the citrus group in southern Europe.†

In California this same fungus attacks the roots of the various stone fruits, including almonds, and also olives and walnuts, and has been found on common live oaks‡ at Berkeley, and on the bay laurels.§ Our data, as to its distribution in the State, are incomplete, but it doubtless occurs rather frequently wherever there is or has been deciduous forest. What is without doubt the same fungus occurs rather commonly in various parts of the United States and appears to be attracting considerable attention as an enemy of fruit growing in various places. The same or a very similar fungus is one of the best known enemies of forest trees in southern Europe.

The disease is very quickly recognized both by its striking effect in the orchard and its characteristic appearance on close examination. The affected areas in an orchard are usually small at first, one or two trees, perhaps, being all that are affected in the first year. The following year one or two adjacent trees may become affected, and so on from year to year. Sometimes an affected tree may live through several years, but usually the tree dies rather soon after the top shows the first symptoms. Sometimes a tree is found with the whole root system killed and most of it in an advanced stage of decay, and the top scarcely showing any sign of injury. This is possible because the dead roots when surrounded with abundant moisture continue to keep up the water supply for the top for some time. In this case it is not long until the top will die suddenly. The seriousness of the disease depends upon its continuance in the same place. Histories of these affected areas over many years are difficult to get, but we have no reason to suppose that the disease dies out of itself while trees are being grown on the land. As to how long the fungus will live in the soil is largely a matter of conjecture. Young trees planted in these areas usually become affected before reaching maturity, so that they are practically a complete loss. The fungus lives not in the soil itself, but in the dead roots in the soil. So far as I know, no reproductive body capable of lying dormant for long periods is formed. It is reasonable to suppose that when the roots are completely rotted the fungus will have no more food and in time will die.

The appearance of the fungus is very striking, and it assumes several easily recognizable forms. In the first place, in digging down beside an affected root, numerous black strands will be seen lying against the root or running out for a few inches into the soil. These strands very much resemble small roots, but, on close examination, it is seen that they do not branch in the same way as tree roots. They are about the size of the lead in a common lead pencil, or a little smaller, and are more or less crooked or wavy, forking sometimes. If they are broken open they

* *Armillaria mellea* (Vahl) Quél. Mycologia, Vol. I, No. 2, p. 2, Pl. I, fig. 2, is apparently identical with or nearly related to this fungus.

† *Agaricus* (*Armillaria*) *citri* Inzenga, O Penzig, Studi botanica sugli agrumi, p. 308 and Pl. XXII, fig. 2, is said to occur on decaying lemon roots in Cicily. It is doubtful if this is the same as the California fungus.

‡ *Quercus agrifolia* Neé.

§ *Umbellularia californica* Nutt.

appear to be hollow, with a small amount of whitish material inside. Where one of these strands comes in contact with a healthy root, it becomes attached to the bark and sends out a whitish fungus growth. which penetrates into the soft part of the bark and sets up a very rapid decay.

The appearance of the outside of the affected root is characteristic as well as the inside. If the strand has been in contact with the bark only a short time, nothing will be seen except a blackish stain spreading out from the strand; at this stage the soil separates easily from the bark as in the healthy root. Where the disease is more advanced, however, the affected bark is considerably swollen and is so soft that it can be broken easily. The soil does not separate easily from the bark in this stage, and, even after a careful washing, more or less remains clinging to the surface. Doubtless there is an exudation of some gummy material which hardens on the outside and holds the soil particles. When the bark is torn off it is found to be thoroughly softened, and it may be separated off so as to expose fan-shaped pieces of felty white fungus, which may be an inch or more in length and nearly as wide. When the line between the healthy and the diseased bark is examined carefully, it is seen that these white, felty, fan-shaped pieces of fungus are pushing their way into the sound bark, but that they are always preceded by a watery and somewhat brownish decay, which causes the bark to soften and form clefts or pockets into which the fungus can spread. The odor of this decay, when it is new, is not at all putrid, but is an earthy, sharp, almost agreeable smell of fresh mushrooms.

During the wet weather of early winter, when badly affected roots are examined, the bark will be seen to be rather prominently raised in irregular ridges. Some points in these ridges become very much thickened and give rise to clusters of large brownish toadstools. A dozen or more toadstools, six to ten inches high, and each one three to five inches broad, may grow up from a thickening not much more than an inch long and three quarters of an inch broad. These toadstools are grayish brown on top and smooth, but showing fine dark brown scales which are small tufts of appressed fibers. They are nearly white below. Objects immediately beneath them are frequently seen to be covered with a fine white powder. This powder is made up of enormous numbers of minute spores. We have germinated these spores in the laboratory and have succeeded in reproducing the fungus, although only a part of the spores grew in our experiments. In nature it must be exceedingly rare that one of these spores succeeds in becoming established in a new situation; otherwise there would be no foot of soil left in the State which was not infected with this disease. Recommendations for its treatment usually include the immediate destruction of all these toadstools before they have produced their spores, and this is doubtless a wise measure. A considerable number of moist days in succession is needed to bring out the toadstools, so that in some sections they might never be formed, even though the disease was present.

There are a great many different species of toadstools which appear in the moist winter weather in California, but so far as we know, this is the only common one which is an active parasite. There will not be much difficulty in distinguishing the toadstool which causes root rot after once becoming acquainted with it. It can usually be recognized by digging down and finding its work upon the roots of some tree.

Those who wish may use it for food. It is not the best in quality, however, and is sometimes too bitter to be edible.

In addition to being a powerful parasite, this fungus is also a vigorous wood destroyer. Where some of the roots of a tree are affected, it will be found that the deeper roots are more completely rotted than the upper ones, and, if there is an abundance of moisture, the lowest will be found in a condition as soft as new bread and saturated with water. In all wood in which we have observed its effects, it produces a white rot, the surface exposed to the air being covered with a dark brown membrane; some wavy brown lines are also formed in the wood. Where it destroys thick bark, like that of the oak, a material is formed very much suggesting soft-cooked white or yellow cornmeal, with the surface covered with a brown membrane and numerous wavy brown lines in the decaying bark. It will be noticed that this fungus works from the outside inward; the outer layers of bark are affected usually before the inner. This distinguishes it very sharply from the various heart rot fungi.

Various remedial measures for this disease have been suggested, but there is still considerable difference of opinion concerning them. The European remedy is to dig a ditch around the affected area and thus prevent the spread of the fungus, but California orchardists object to cultivating and irrigating across a ditch. We have observed that the fungus seems to have very little power of spreading in soil which is moderately dry. Possibly it may be controlled to some degree by keeping the soil from becoming too wet. The grubbing out of all affected trees and of those at the edges of the diseased spot has been recommended; it is not sure that it will be possible to dig out and remove from the soil all of the roots so that the fungus will not still be able to spread slowly from one root to another, and continue the infection in the soil as well as continuing to enlarge the affected area; yet the removal of affected roots from the soil would seem to give the new planting a better chance, even though the danger can not be entirely avoided in this way. Trees planted in affected areas frequently live for a good many years, but it is possible that even the best of them will succumb in time. Where no attempt has been made to remove the diseased roots, we have found the roots of the newly planted tree well infected within about half a year. It has been recommended to use large quantities of disinfectant in the holes where the affected trees were dug out, but the results of this treatment do not seem to have been observed sufficiently, and it seems very improbable that it can be entirely depended upon.

It has been suggested that probably there are some root stocks which will be immune or resistant to this fungus. We are planting the various citrus roots in these diseased spots with the hope of determining this point. It is said that the pear is resistant. With the stone fruits it is usually so difficult to tell with certainty what stock has been used that it does not seem possible yet to say definitely whether any stock is immune. I do not yet have authentic data to show that the black walnut root suffers, but it probably does. I do not know that figs are affected.

As you see, the amount of definite knowledge which we possess concerning this trouble is very small, and one of the principal objects of presenting the matter to you is to request that you furnish data to the

University, wherever it may be collected, to assist us in this study. The things we desire to know accurately are:

First—What kind of tree is affected? And in this matter it is the root we desire to know about, rather than the top.

Second—What kind of soil does the disease occur in, and is there anything to be noticed in connection with the drainage?

Third—How long has the affected area been developing, and what was the previous history of the ground? If trees have been replanted where others have died, what has been the history of the replants? Does the disease spread downhill more than uphill, and does it spread along irrigation ditches or across them?

Fourth—Have any remedial measures been tried, and, if so, what, and the results?

In order to make sure that no mistake has been made in recognizing the trouble, it will be well to send specimens of the roots to the Department of Plant Pathology, University of California, Berkeley. The specimens should be of good size; that is, it will be well to send several roots, making a package of a pound or more, and these should be carefully wrapped so that they will arrive with as little drying as possible. Specimens may be sent either by mail or express.

It will usually be impractical to send the toadstools in the fresh condition, because they decay very rapidly in a closed box. However, they can be dried very easily by placing specimens which are still firm and in good condition in a draft of warm, dry air. Care must be taken, however, not to get them too hot. Dried specimens are fragile, but in a strong box they can be sent safely, and, if not overheated in drying, can be recognized perfectly.

While this trouble is not a new one, and is not liable to increase suddenly, it is still of sufficient importance to merit very careful study, because we have as yet no satisfactory remedy for it, and it is gradually increasing.

THE PRUNING OF THE WASHINGTON NAVEL TREE.

By JOHN P. ENGELHARDT, Glendora.

JONES: "Neighbor, why are my oranges not as good as yours? I spend as much money for fertilizers as you do, I irrigate just as carefully, and plow and cultivate just as you do. I raise cover crops, too; but my fruit is inferior to yours."

SMITH: "I'll tell you what, Jones, you don't prune enough. You don't cut out the water sprouts and the foreign wood, that is, wood that is not true Washington navel. All your fertilizers, all your irrigating water, all your labor of cultivating and of growing cover crops, is thrown away if you haven't the right kind of wood for your orange-bearing branches."

JONES: "How can I tell the right kind of wood?"

SMITH: "Well, the best way to begin is with the water sprouts, or 'sucker' growths, as they are commonly called. They bear poor, coarse fruit, and that only at their ends or tips. This makes these branches bend down and crowd the fruit below, thus shutting out light and air from otherwise good fruit below them. After the winter rains, and usually after irrigating, you will find many of these young shoots

which sap the tree. It is most important to remove these as soon as they form."

JONES: "I thought one pruning a year was enough, and was just going to ask you the best time of the year to prune."

SMITH: "Friend, that way of doing is all out of date. It is economy to cut out sucker or water sprouts, after every two or three irrigations."

JONES: "Why?"

SMITH: "Because the first thing you know these young shoots rapidly help themselves to a great deal of the sap containing rich ingredients such as nitrate of soda, and what do they give you in return? Wood and more wood; but oranges? none, at least not many, and the fruit that is formed is coarse and tasteless. The more fertilizer you give an unpruned tree, the worse the fruit will be. If you haven't time to prune it is better not to fertilize the tree. The time is at hand when oranges will be graded according to their taste as well as their looks. Do you think we should have so many unexplained so-called 'slumps' in the Eastern orange markets if we really furnished a good orange?"

JONES: "Does the water sprout continue to form inferior wood?"

SMITH: "Yes, the second season fine luxuriant branches form from them, but not fruit-bearing, and mostly wood-bearing. If you take buds from this stock for propagating you produce a very poor nonbearing tree. In fact, to propagate from such stock is slow death to our grand orange industry. What is more, the older these sprouts get, the more they weaken and rob the tree in order to form still more wood. Some people permit these branches to grow wood for ten years, and wonder continually at their meager bank account."

JONES: "Well, Smith, suppose I cut out the sucker growths as soon as formed, shall I get fancy fruit and plenty of it?"

SMITH: "No, not always. Unfortunately, the trees sold us by the nurserymen are not always from good stock. The buds from water sprouts look so fine that some of our so-called 'best budders' use them for propagating, instead of taking buds from pure fruit-growing branches.

If you go from orchard to orchard you will find from twenty to twenty-five per cent more wood than is necessary to produce the same amount of oranges. I honestly believe, Jones, that by pruning properly you can save from twenty to twenty-five per cent of your expenses, besides improving the quality of the fruit raised by ten per cent.

It is necessary to cut out all foreign wood and reduce the tree to the original Washington navel. Did you notice that Riverside man who called here? He declared that the Riverside navel orange is deteriorating, and that he can prove it, too. As for myself, I can say that the Glendora orange of to-day is not as good as it was twenty years ago. This deterioration has been observed for fifteen years and is becoming alarming. I attribute it to lack of pruning largely.

One can soon learn to tell the different kinds of foreign or untrue wood by the shape and looks of the branches. One easily learns what shape to expect from certain kinds of foreign wood. Few ranchers, and even pruners, seem to understand this. By 'pruning' they seem to mean the well balanced shaping of the tree. Some haven't even this idea; but mean by 'pruning' a general lopping off of branches by the 'hit or miss method.' If this thing goes on, the navel orange will

eventually run into culls, and instead of being 'orange growers' we shall be 'cull growers.'

Let me tell you, Jones, a small packing house near by sold twenty-seven car loads of culls to a certain Italian last winter. Besides this, he rejected ten more cars as being too inferior for his trade even."

JONES: "I can not quite accept your statements."

SMITH: "Go to our packing houses, Jones, and look over the fruit as it comes in. Go out into the orchards as they pick the fruit and notice how many different shapes and sizes and colors you will find. For instance, certain kinds of branches furnish pear-shaped oranges.

Oh, shade of the original Washington navel orange, if you should perchance hover over our beautiful southern California, what queer shapes and monstrous forms you would find masquerading under your magic name.

When we learn of 'slumps' in the orange market it frequently means that we have shipped a mass of inferior fruit, or fruit that is not true to name, and that the public can not be induced to buy. How often we find fault with the managers of our associations, or the packing houses, when the fault is ours in not furnishing fruit of pure, good stock. In fact, there are from three to four kinds of worthless wood growing in our fine orange trees. This must be removed, even if it takes half the tree."

JONES: "Why is it that we have such extremely large and extremely small fruit on the same tree occasionally?"

SMITH: "The tree is not well balanced, some of the wood is too thick and rank."

JONES: "Do you think the old Australian navel tree can be properly rebudded and made to bear fine fruit?"

SMITH: "I have had a budder try three times and he failed each time. His buds were at fault. He insisted on taking them from water sprouts. However, I budded sixteen trees myself with good stock and succeeded in each case."

JONES: "What can we growers do to remedy this state of affairs. It is not possible at the present time to secure skilled help on the ranch; we must educate help."

SMITH: "I believe that we ought to have scientific pruners, men who have studied 'pruning' at an experiment station under Government control. The United States Government is helping the corn and wheat growers of the Middle West by furnishing them with selected seeds, and is educating them by means of 'Farmers' demonstration trains.' The Government will do as much for the orange grower if he desires it. Isn't our orange industry worth as much as the corn and wheat industry?

Glendora ought to have an experiment station. We could teach pruning and would only allow men with certificates to prune.

The San Dimas Lemon Association claims that it saves the growers much money by having the picking done in accordance with suggestions from the Department of Agriculture. Surely to have our pruning done under the same supervising help would benefit our industry.

Unless something is done soon, the next generation will 'run out' the Washington navel tree and grow instead the 'cull' variety. My motto is, 'Pure Wood makes Good Fruit.'

In spite of all care in budding and pruning, we may still not make great headway in getting fancy fruit, owing to the original seed from which the stock was grown. Fancy seed corn in Kansas sold at the rate of $2,000 a bushel this summer. Do we ever investigate our seed for stock? Then, too, Kansas seed produces annual plants, but orange seed produces trees that live a lifetime, good or bad. One mongrel seedling or old lemon tree of poor quality may do thousands of dollars of damage. Another thing I have noticed, friend, is that we are trying to build up large full-bearing trees on an inferior root system. The demand for nourishment is thus greater than the supply, especially since the trees are only twenty feet apart. We must, in that case, reduce the tree above ground by vigorous pruning."

ALTERNATIVE PAPERS.

The following papers were prepared at the request of the Commissioner to be read before the convention in case all the time was not taken in the consideration of topics named in the convention call. As the meeting progressed, it was discovered that the two-days' session provided for was not adequate for the work outlined in the regular program. Hence these alternative subjects were not discussed or the papers read at the convention. The article upon curing and coloring fruit was prepared at the request of a Pomona fruit grower.—J. W. J.

IMPROVING THE ORANGE BY SELECTION.

By Carroll B. Smith, Redlands.

We have accepted the Mediterranean, Florida, and Brazilian types of oranges and lemons as they came to us without questioning the possibility of their further improvement. When introduced they grew easily and splendidly, and at first free from pest or disease. It was natural, therefore, that as the acreage increased, and when the marketing began, all efforts should be turned toward production, that is, toward quantity rather than quality.

The earlier planting was on lower ground, where water would flow easiest. Generally speaking, the soils in such places were too heavy and the situation too cold. Later, the ditches were laid higher and tapped the streams higher up the canyons, so that water was conveyed to the elevated, well drained mesas where, under more perfect conditions, production multiplied rapidly. The quality and surety of the crop was here all that could be desired. The first improvement of citrus fruits was thus along the line of congenial environment.

The fact that no species of plant life is "fixed" is now attracting general attention. No two plants are exactly alike. The variations enable plants to adjust themselves to external conditions.

It is a far cry from the wild seedling to the present type of orange, with its thousand variations between. It is easy to believe that if the orange thrives so easily with us, its present type is superior in some respects to the type of its first less congenial environment. For

example, they say the Washington navel is not so regular a bearer in Florida as it is in California.

Apples, tobacco, cotton, corn, sugar beets, potatoes and many other products have been improved by "selection." Crossing by pollination has been a factor in most of these, but the navel orange having no pollen can not be used to cross another variety. How, then, can it be improved? If you pollinate a navel orange blossom with pollen from a grape fruit or seedling orange its fruit will bear seed, and this characteristic if established would not be desirable. Nevertheless, observation and attempts at "selection" have already gone far enough to show positively that the navel orange of itself, apparently without any external influence, or any known cause, does vary decidedly. Instances are known where single branches on trees have shown distinct variations for four or five successive years, while the balance of the same tree averaged with the rest of the orchard. The Thompson Improved is a well known illustration. Of course, if one works with seed-bearing varieties he has the additional aid of crossing by pollination. This breaks up "fixed" or hereditary habits, which may or may not be perpetuated in the progeny.

In a whole field of Marguerites perhaps only one gave any promise of the "Shasta Daisy." But that one "selected" or propagated tended to yield less of the original type and more of the new desired. It may require many generations, but eventually any new type can be quite well established.

Difference in the quality and prolixity of groves is commonly recognized to-day. Any real estate dealer can show you groves of exceptional reputation for large yield. Ask any packing house manager whose fruit graded the most fancy in his house, and he can at once point you to several whose average of fancy was higher and whose culls were less. These are not necessarily cases of soil or culture, though they may be in some instances.

I know of an orchard where the foreman has been familiar with every tree for nine years, and he can point you to five or six trees that will average a better quality and appearance than any other six in same orchard; and of these six two have never in nine years failed to yield from twelve to fifteen field boxes of navels. Some may miss a year now and then, others may often miss, but the regularity of the two mentioned is evidently exceptional and worthy of propagation as a possible improvement. Whether the progeny will come true to the original stock remains to be seen. If we could establish some pedigree system of taking the yield of every tree each season, I have no doubt we would soon improve in any desired direction.

I know of a small orchard the fruit of which will ripen every year about November 1st. The fruit is almost seedless, good color, and sweet to taste. The stock was obtained twelve years ago from a chance seedling that bloomed early in its nursery life. The owner marked it and propagated it as a curiosity, with the result that to-day he can guarantee ripe, sweet oranges for Thanksgiving every year.

There is the question of sugar content. I believe this could be increased if only we go after it with some system. This involves suitable laboratory equipment and expert assistance and takes time—yes, years. But the work and system should be inaugurated now, if possible, with the present maturing crop.

The question of outside appearance is essential to good selling quality. Thin skin, rich color, high sugar content, full juice, and a good carrying quality should be looked for in the navel orange. We also want a Valencia that won't turn green a second time. A lemon as highly acid as possible. A grape fruit that bears desirable sizes and does not have an off year, and other citrus varieties too numerous to mention.

Prof. Ralph Smith of the Whittier Station knows of a navel tree whose fruit ripens months later than is usual. A late navel, even if it had no better qualities than the present type, would lengthen the shipping period.

This subject of improvement by "selection" should be agitated, and observation encouraged along suggested lines. You may pass the improved orange daily and not know it.

Professors Coit of the Whittier Station and Norton of the Riverside Station, or the writer, would be glad to receive notice of any promising variations. Mr. Shammel, also of the Department at Washington, is now with us with the express purpose of improving the orange by selection. We can all try to assist in this work by noting desirable variations and reporting the same.

What would be the effect on the demand for our fruit if we could constantly improve its quality, size, or appearance?

To use the words of Luther Burbank: "The vast possibilities of plant breeding can hardly be estimated. It would not be difficult for one man to breed a new rye, wheat, barley, oats, or rice which would produce one grain more to each head, or a corn which would produce an extra kernel to each ear, a potato to each plant, or an apple, plum, orange or nut to each tree.

"What would be the result? In five staples only in the United States alone the inexhaustible forces of nature would produce annually, without effort and without cost,

5,200,000 extra bushels of corn.
15,000,000 extra bushels of wheat.
20,000,000 extra bushels of oats.
1,500,000 extra bushels of barley.
21,000,000 extra bushels of potatoes."

INSECT CONTROL.

By Prof. A. J. Cook, Claremont.

The subject of scale insects and their control is one whose importance to the citrus industry, and to the perpetuity of the citrus orchards, can hardly be exaggerated. Else one of our most competent orchardists would not have paid out more than $25,000, in a single year, in fighting these pests; else hundreds of thousands of dollars would not be expended annually to subdue or eradicate these scale insects.

I assert positively and confidently the truth of the following propositions, in the light of actual experience: (1) Scale insects can be controlled at an expense, not at all prohibitive; (2) Fumigation, especially in the orange orchard, is the only sure specific against most of these scale pests yet discovered; (3) Fumigation rightly managed need not be repeated oftener than once in two or three, I believe four years; (4) As practiced, fumigation is often very inefficient. Orchardists bid for

cheap work, too cheap to be effective, contractors whittle dosage below the killing point, and guesswork completes the mischief; (5) Despite the large annual expense in fighting scale, the loss from infestation, through injury to fruit and depletion of vigor of trees, is frightfully great, and the increase of scale infested territory is certainly alarming; (6) Near the ocean, especially, irregular hatching of the black scale results in the presence of the insect in all stages of growth, from egg to mature scale, at all times and seasons of the year, and so the problem is even more complicated, and may make a double fumigation, in quick succession, wise and necessary—in any case, the motto must be "Clean fruit and clean trees always"; (7) We must have horticultural commissioners, thoroughly taught in entomology, with the energy and vigor of youth, who will be quick of observation, and who will insist that all orchards be kept clean; they must be fired with ambition and love of the work; such are not born of politics. Our law must be amended so as to give but one commissioner, with the single qualification of knowledge and fitness; (8) Our orchardists must be convinced that no greater asset can be secured than the fact and reputation that our region is scale free. Like the King of Babylon, our old methods, or lack of method, is "Weighed in the balance and found wanting." True, much good has been wrought, enough to demonstrate magnificent possibilities. A great dose of inefficiency, all these years, has cost the growers millions of dollars, and calls loudly for a better way. One orchardist near here paid a year ago to have his grove fumigated the sum of $12.00, and now the orchard is black with smut. Such examples are not lonesome from lack of companionship. Our growers know that a better method is imperative and so the exchanges in this section,—Pomona, Claremont, San Dimas,—have inaugurated what must be a tremendous improvement all along the line.

The Southern California Fruit Exchange has been rightly called the savior of the citrus industry. Its work to develop the markets for our fruit has been as successful as it has been colossal. Its influence secured to us the greatly needed advance in the lemon tariff; so says Senator Flint. Its work in securing cheaper supplies and in inducing better methods of handling is worthy all praise. It is hard to say which should most exalt our pride, our magnificent citrus orchards, or our phenomenal coöperative organization—the Southern California Fruit Exchange. The exchange has still a further mission, which it recognizes, and hastens to fulfill. This is nothing less than the solution of this question of "Insect Control."

Fumigation is night work; mistakes in dosage, and even omissions are easy to make. Yet absolute thoroughness, and entire absence of mistakes are imperative. To secure all this *always* and *every time,* requires managers who are full of energy, whose interests are all enlisted, whose faculties are all awake. To have a business of such importance and magnitude where mistakes are so frightfully expensive, in charge of irresponsible parties—the lowest bidders—is as unbusinesslike as it is ruinous to the fruit and orchards. The exchange can secure the right man, whose every interest will be awake, who can force efficiency, and thus save immensely to our citrus growers. With the Morrel system, guesswork will be banished; with this wiser management, mistakes will be reduced to the minimum, and we have only to adopt the "block

system'' to complete the grand round of improvement, which must be a godsend, indeed, to our growers and to our section.

The manager must be a keen observer, fully equipped with information, of great energy, and of great executive force and ability. Such competence always commands good pay, and we must follow the lead of all great business firms, and pay liberally for this service. Our manager must dream of his work, in his overmastering desire that it shall win out. He must have carte blanche to secure and maintain the very best of tents, to use an ample dosage, and to have efficient and enough help to push the work to the utmost.

Again, each grower should be willing to sacrifice individual interest to the general good, that the manager may have entire support as to times and seasons. He will heed wind and variety of scale, and plan that the work will not need to be oft repeated. Thus, in the end all gain immensely.

Sicily, if she has older and more vigorous orchards than we, may rightly charge it up to her scale free trees. No doubt but protected fruit will stand up longer and better in the marketing.

This section is to be congratulated on the enterprise that has inaugurated this splendid reform. We believe that she will carry it on to a convincing success; that soon all southern California will swing into line, so that our orchards will be as matchless in their freedom from insect despoliation as is our scenery in its grandeur, or our climate in its agreeableness and salubrity.

THE COLORING OF LEMONS AND ORANGES BY OUR SWEATING PROCESS.

By L. B. Williams, Whittier.

Having been drafted by our Honorable Commissioner of Horticulture to write a paper for this convention, entitled ''The Coloring of Oranges and Lemons by the Sweating Process,'' and realizing the various ways and conditions by which oranges and lemons can be colored, and that there are no ironclad rules that can be laid down at the present time, I asked for the privilege of inserting in the title the word ''our'' instead of ''the'' and was kindly granted the changing of the title to ''The Coloring of Oranges and Lemons by Our Sweating Process,'' thus allowing me to tell our experiences in a plain, simple way, giving a brief outline from our first experiments up to the present time. It is necessary to begin at the beginning in order to clear the points I wish to make. Our first sweat room consisted of a small room, single wall paper lined, large enough to accommodate one car of fruit at a time. This room was in the main building; in fact, it constituted the largest per cent of the main building at that time. The fruit was washed and placed in our picking boxes and trucked into this room, stacked ten boxes high, papering the top box.

When the room was filled, or nearly so, it was heated with kerosene stoves. The first stove was the kerosene drip stove; next we used the ''Perfection B,'' also Perfection No. 813B, which is the same stove as far as the writer can see. The temperature of the room was held at ninety degrees as near as possible, this being the maximum. The temperature was regulated by the number of burners in the room. It was

necessary to keep the fruit moist to keep it from wilting. This was done from evaporation by placing a vessel on the stove and filling it with water, the amount of moisture depending upon the number of burners required for the temperature, so the moisture at this time automatically adjusted itself.

If we wished the fruit colored quickly, this process would continue day and night. Our pickings increased until it was necessary to have more sweating accommodations. Not being satisfied with all conditions, and believing that improvement was soon at hand, we decided not to build just then, so we moved out into our regular storing tents, using the kerosene stoves for heat in the same way, only more of them were required, considering temperature only.

Having more room and fruit, it was necessary to have more stoves. The old Perfection B had had its day and the new Perfection taken its place, consequently we purchased new Perfection. We soon discovered the new stove did not color the fruit. It gave off the same amount of heat, also evaporated the same amount of water, was much nicer to manipulate, but decidedly slower to color. Very often we were required to make a change, taking out the new stoves and replacing them with the old in order to complete the job. The old stoves threw off a large volume of pungent gas. This being the only difference we could see, led us to believe that there was some virtue in the pungent gas. We also discovered we could shorten the time of coloring in tents by making them two thicknesses, placing one over the other, thus more closely confining this pungent gas.

We carried on a few small experiments at this time which served to strengthen our opinion that this pungent gas was an important factor in coloring oranges and lemons.

While sweating in the room and tents, the stoves were on the same floor with the fruit. This had several objectionable features, namely, the fruit would not color in the bottom box as soon as in the top. They had to be turned out and removed every time we trucked fruit out. This was dangerous, as the stoves were liable to be struck with the trucks, causing leaks or fire.

Feeling the need of better accommodations and having in mind all the points we had picked up from past experience, both good and bad, we planned to build a new sweat house, one that would cover all the good points and overcome the objectionable ones. We also decided to build as nearly fireproof as possible, independent of the main building, and thus eliminate the danger of fire, especially to the main building. We at this time had the good fortune of having an assistant to help plan and build such a sweat house, this party having had successful experience in firing from the basement. The basement idea would overcome the objectionable feature of having the stoves on the same floor.

Pardon me just here and allow me to deviate slightly from the subject, and I will give a brief description of the sweat house. We first staked out a piece of ground 42 feet by 46 feet, inside measurement, being sufficient for six rooms 14 by 20. We excavated for each room, making a basement 12 feet by 18 feet at top, allowing it to taper at about 45 degrees, 6 feet in depth, which gave us 5 feet by 8 feet 6 inches at the bottom for stove floor. The tapering wall prevented it from crumbling and gave sufficient strength to carry foundation and partition walls. We excavated an aisle 4 feet 6 inches, tapering to 3

feet at the bottom and running lengthways of the building. There are three rooms on each side of the aisle, with doors entering from the aisle, which enables us to go into the several rooms independent of each other.

Water is piped to each room. There is electric wiring in conduit throughout the building. Also allow me to mention, in passing, that two fire escapes have been wisely provided, in addition to the main stairway, making a total of three possible ways for a man to escape in case of fire.

Now we come to the upper rooms. The main outside walls are of concrete, 6 inches thick, 8 feet high, with a small window in each room. The ceilings and partitions are of 1-inch tongue and groove redwood. A 6-foot aisle runs lengthways of the building, with doors the full width of the aisle at each end. There are three rooms 14 feet by 20 feet on each side of the aisle, each room independent of the other. The floor is made of 2 by 6 Oregon pine, laid with ½-inch openings between each, affording ample room for the heat and gas to come through. The gables are ceiled with 1-inch rough Oregon pine, covered on the outside with sheet iron. There are three doors in each gable, which allow a large per cent of natural heat to escape. They are so arranged that by pulling a small cable in or out of sweat house they can be unlatched, closed and latched. This was provided so that in case of fire they can be quickly shut, which would protect the sweat house from any outside fire. In case of the fire starting in the sweat house, this would confine it to same and protect the outside buildings. The roof is of galvanized sheet iron, with vent in top. This vent can also be closed by pulling a small cable.

There is a 5-foot by 8-foot galvanized sheet iron secured to the upper and under the main floor over the burners in the basement to prevent flames or the heat coming direct on the fruit, in case we are not using vessels on the stoves.

Now, back to the coloring of the fruit. Here I will speak of the oranges and lemons separately, as we find we have better results treating them differently. I will speak of the oranges first. The green and yellow are separated at the washer, placed in packing cases stacked eight high, the fruit in the top case being covered with paper. The fruit is then trucked into the sweat room, trucking the dark green in first and placing it farthest from the door. The rooms being 14 by 20 affords ample room for one car or 600 packing cases to each room. The boxes stacked eight high prevents restacking in the sweat room. The fruit is trucked 5 rows in each room, 120 boxes to a row, and 5 inches space between each row, thus allowing room for the removal of the clamp trucks. The fruit is set in with a small space left between each stack, say 1 to 1½-inch, which is ample room for the heat and gas to equally distribute itself. Having the stoves down in the basement makes it possible to truck fruit in and out of sweat room without disturbing same. They are low enough to afford uniform coloring top and bottom, holding the temperature of the room at about 100 degrees as near as possible, 100 degrees being the maximum. Moisture is used sparingly. We have not been able to secure a hygrometer that will give us sufficient accuracy in the sweat room to be able to establish a fixed humidity, so we are compelled to go by observation. We supply our moisture from evaporation, using just enough to keep the fruit from wilting, and watching that there are no beads of water collecting on

the fruit or ceiling, working for reddish orange color. The color is improved by quick action, firing continually until well colored.

Now, the sweating of lemons. You will note the difference in temperature, humidity, and time allowed to color. If the sweat room has stood with long intervals between usage, we go into the room thoroughly wetting the walls, ceiling, and floor before we allow any fruit to go in. First, washing the fruit, we divide the green fruit into three or more shades: Dark green, light dark green, dark light green, and light green. We think it is imposible to put too much care upon this important position at the washer, consequently we see that there is a competent hand at this place. If this classifying is well done the fruit can be handled in such a way as to receive the best results from the room.

I might say here that at this time of year, or when we are getting a per cent of the new crop and a small per cent of the heavy dark green is rough and coarse, if it is stored elsewhere for about ten days or two weeks before going into the sweat, it will improve both in color and quality.

The lemons are trucked into sweat room from washer, trucking in the dark shades first, lighter shades next, and working the lighter shades to the door as the light green colors should come out first, thus allowing the fruit to be uniformly colored. We find a difference of twelve to twenty-four hours in the time required to color the different shades. In firing from the basement we endeavor to produce all the gas we can, paying close attention to the temperature and holding it as nearly as possible to ninety degrees, this being the maximum. Lemons require much more moisture than oranges, and should have a sufficient amount to prevent not only wilting but to prevent the heat from baking the color to a ripish or dark yellow. In lemons we work at all times for a whitish yellow. The humidity can vary to quite an extent before there is too much, but I am unable to say just what per cent. But to speak again from observation, there must be beads collecting on the ceiling and fruit. This moisture is supplied by evaporation. Occasionally we have a room of fruit that drinks up all the moisture we can supply by previous sprinkling and evaporation. When this condition presents itself we attach the hose to the hydrants in the basement and wet the fruit down, soaking everything in the room. We also go down in the basement and sprinkle the walls heavily.

A much better color is secured if more time is given to the sweating, say firing at intervals instead of firing continually.

We have carried on various experiments, working with hopes that we could discover a way by which lemons could be quickly colored and retain their buttons. Results of our work so far have proved that this combination can not be accomplished, but can be done separately. The buttons will not drop off if much more than the ordinary time is given to color. Our experiments served to strengthen our conclusion that the pungent gas was the prime factor in coloring the fruit, also was the whole factor in throwing the buttons, while, as I have said, if a small quantity of gas is put to the fruit it will color it in time and not throw all the buttons, but a large volume of gas will hasten the color but throw the buttons, very often before the fruit commences to color.

About the fall of 1908 Prof. R. H. True, assisted by A. F. Siever from the Government Bureau of Plant Industry, came here and took

up the work assigned under their industry. Shortly Professor True was called elsewhere. Mr. Siever carried on various experiments, testing the life of a sweated lemon as compared with natural cured; also making chemical analysis of the lemon, which came out in Circular No. 26, issued May 26, 1909.

He, working in conjunction with ourselves, carried on various experiments, again proving in all experiments that the gas was the prime factor in coloring fruit.

It will be the pleasure of the Bureau of Plant Industry to hand out a circular giving the particulars of all experiments and results carried on during two seasons while here. This will be done in time. I wish to say that we carried on sufficient experiments to place us in a position where we could see that we were in a large field—room for difference of opinion under the same conditions. The cause underlying this great difference is not fully understood at present, but the results of the experiments so far invite a more interesting study of the sweat room.

In closing I will say that I believe the time is near at hand when we will be able to generate our gases for a large amount of fruit from a small amount of fuel, thus reducing the cost of labor, cost of fuel, and last, but not least, reduce the great danger of loss by fire.